the OIL AND GAS JOURNAL

SEPTEMBER 30, 1957

For the oil industry, at least, the

ENGINEER SHORTAGE

is far from over . . .

Supply is tightest for petroleum, mechanical, and chemical degrees

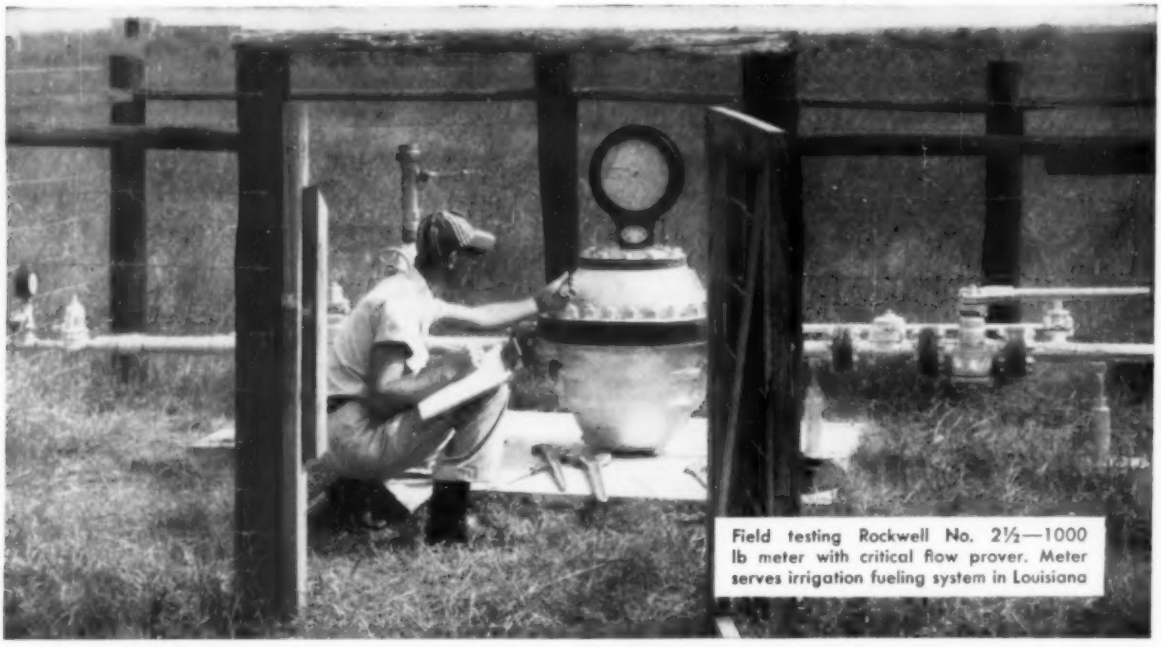
p. 52

Editorial: What About the Final Quarter? p. 45

Liner Completions Make Low-Cost Duals p. 77

Ethylene Oxide by Direct Oxidation p. 81

HOW TO MEASURE GAS AT 967 lbs. PRESSURE



Field testing Rockwell No. 2½—1000 lb meter with critical flow prover. Meter serves irrigation fueling system in Louisiana

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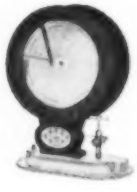

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The OIL AND GAS JOURNAL Newsletter

Sept. 30, 1957
Tulsa, Okla.

What the oil industry needs is a cold, dry, long winter:

Abnormally cold weather would force home owners and industries to burn more fuel oil.

Dry weather would permit motorists and truckers and maybe farmers to drive their vehicles more and use up gasoline, diesel fuel, or LPG.

A long winter under these conditions would increase the volumes of products purchased.

The result would be a much healthier market outlook next spring for marketers, refiners, and consequently producers and the rest of the industry.

Some marketers frankly say it will take just such a stimulant in demand to pep up the industry. They size up the market like this:

...Middle distillates still weak.

A hint of this is Esso's action on the East Coast in moving the time limit for purchasers to take advantage of summer discounts ahead to October 31. This gives buyers a month more to take the half-cent-gallon discount. It indicates too much stocks are on hand to support winter rates in the warm weather now prevailing.

...Gasoline remains spotty.

Sporadic gasoline wars are still popping up. Summer driving season is over, and some refiners are looking for spots to dispose of heavy stocks.

...Crude shows signs of remaining firm.

But this is being achieved at a heavy cost to many domestic producers. Texas has cut allowables to 12 days. Many other prorated states are keeping allowables the same but are encountering buyer proration.

Will Government get tough enforcing voluntary control program for imports? Answer will come within days.

Decisions on appeals from their quotas will be given seven importers only after talks at highest government levels. But both Interior Boss Seaton and Imports Chief Carson are confident. They believe oil industry will go along with the program despite any quota adjustments.

If companies don't cooperate, Government can take these courses: Do nothing. Impose mandatory quotas. Wait for Congress.

Drilling men now can assess the value of a new tool: A wire line retractable bit (p.50).

Carter researchers revealed details of their development before a Tulsa A.S.M.E. conference last week. The collapsible bit can be run up and down the drill casing on a cable. It opens up for work when engaged with the drill collar at bottom of hole.

Tests show savings of 25 per cent in penetration costs may be achieved. Penetration rates are about equal to conventional drilling methods. But savings are realized through time and labor saved by eliminating round trips with drill pipe and through less investment in equipment. The heavy derrick and draw works are eliminated.

Tool isn't available for industry as yet. It still faces further development work and testing by the manufacturer.

Here's the latest evaluation of other drilling trends:

...Air and gas drilling has an assured future because of sharp savings in time and money. It will come into its own, however, only when researchers find solutions to seal off water zones. Problem now is being attacked in the laboratory, and reports are that at least one company is near an answer.

...Aerated mud drilling depends on two developments: Solving problem of sloughing shale and greater cutting-carrying capacity of the mixture.

...Handling 15,000 psi. soon may be routine. Wellhead assemblies, high-strength tubing, and new completion techniques already have been developed for the job.

The drilling score for August is just in:

Completions totaled 5,506 for the month with 2,222 wells dry. This compares with 4,299 completions in July and 1,718 dry holes. (p. 142).

So far in 1957, operators have completed 35,566 wells with 13,489 dry. That's down from the same time last year when completions totaled 39,500 with 14,586 dry.

Note the risk in wildcatting: 1,162 wildcat wells were drilled in August, and 1,040 were dry.

Exploration spotlight for August centered on:

...Paradox basin, where Utah got first Mississippian production.

...Texas, where new oil province shapes up in Sheffield Channel, the Edwards production was expanded into Live Oak County, and new pay was found at Bethel salt dome.

...Canada, where third Devonian discovery was made in Virginia Hills region and second Innisfail discovery promises major reef find.

A low-cost plan for dual completions has been devised by operators for San Juan basin gas wells (p. 77).

Operators run a liner below the intermediate string instead of another full string of pipe. By perforating a zone behind the intermediate string and a zone behind the liner they have a low-cost dual.

Mike Benedum may have a major strike in Northeast Ohio.

The Benedum-Trees Oil Co. 1 Scribner had initial flows of 30 bbl. in one 15-minute test, and flows of 38 and 70 bbl. in later 15-minute tests.

Field reports say 7-in. casing has been cemented through 100 ft. of saturated Medina which was fractured through perforations. Production tests will be made this week when more tankage becomes available.

Benedum interests hold more than 10,000 acres in the vicinity.

Exploration notes: Pan-American will take its record-breaking Pecos County wildcat down to 21,000 ft. It was at 20,704 ft. last week still in Barnett shale...Magnolia and its partners have halted their 1 Sterba at 20,446 ft., an Oklahoma record. They plan to plug back up the hole and attempt to complete in the Stringer at 14,510-40 ft....Production from that important Michigan well, the 1 Stevens in Hillsdale County, will really help Aurora Gasoline Co. Its refinery is close enough that Aurora can save 34 cents a barrel on oil from the well in which it owns an interest....Persian Gulf offshore region is the coming oil province of the Middle East. Big problem is to decide who owns what in the gulf.

There's dynamite in the way Governor Mechem retaliated for Gulf's purchaser proration in New Mexico.

Mechem called in all Gulf credit cards issued to state offices and departments under his jurisdiction. Gulf had cut purchases in New Mexico by 20 per cent starting in August.

The governor says he also might call in Magnolia credit cards. Magnolia also has cut crude purchases in New Mexico to 76.5 per cent.

Mechem indicated his strategy of hitting back through the gasoline pumps was: Reduce purchases from companies that buy foreign oil in preference to New Mexico crude.

Refiners are still boosting octanes on premium grades.

Average premium over the nation climbed to record high of 98.2 octane numbers in September. Regular remained at 90.9.

Two trends noted in September: More suppliers are marketing premium in the 99-100-octane range...Average rating of super-premium brand is up to 100.9.

Ethylene oxide producers have cemented their No. 1 rank as the largest users of ethylene. Predictions are this ranking will hold through 1960 at least.

The result is a rush to get new ethylene oxide plants into production. The trend for most of this new capacity favors the direct oxidation process over the classical chlorohydrin route.

By next year direct oxidation will represent 57 per cent of U.S. plant capacity, a reversal of the processing picture since 1953.

A chemical expert discusses the objectives and problems faced

by processors taking up the direct oxidation route in an article on p. 80.

Refining notes: Suntide is now on stream with two units at its Corpus Christi plant. One is the largest catalytic reformer ever built for an independent...Warren and Sunray plan natural-gasoline plant near Mocane in Oklahoma's Beaver County...Researchers are predicting more and more gas turbines will be put to use in refineries within the next few years...West Coast refiners have 19 building projects either started or planned and stretching from Alaska to San Diego...A new refinery at Port Reading, N. J., is being planned by Hess Transport & Trading, Inc., major fuel marketer in New York area...Reports are current in Canada that K. C. Irving plans a new refinery at St. John, N. B.

Rangely field becomes unitized this week—the second largest unit in the nation in terms of reserves.

A stepped-up program of secondary recovery and conservation is planned immediately. California Co. will put down two gas and two water-injection wells on field's periphery. Equipment is being relocated and consolidated. Flaring of gas will be cut from 45 million cubic feet to 5 million soon and before end of the year will be eliminated. Eventually the entire field will be flooded.

Prescription for curing Long Beach's subsidence troubles has been handed city officials. Three experts give these alternatives:

...A 780,000 bbl. daily flood costing $25 million will maintain pressure in Wilmington field at present levels.

...A 1,000,000 bbl. daily flood costing $32 million will increase field pressures to their original levels within 3 years.

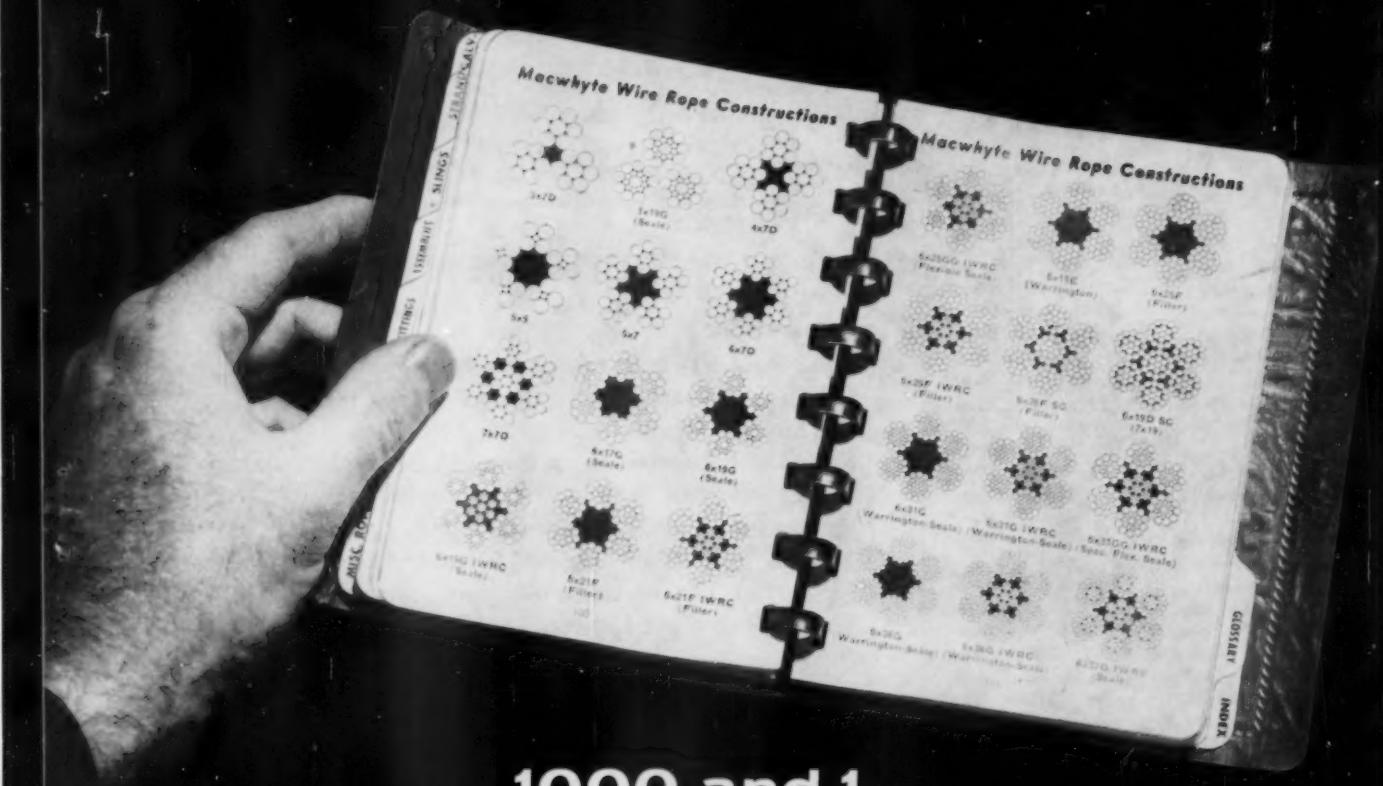
...Do nothing and ultimate depth of the center of the subsidence bowl will reach 43 ft. by 1977.

One expert declared all evidence points to oil withdrawals as the major cause of the land sinking (p. 47).

Shortage of engineers and technical personnel will plague the oil industry for several years, a Journal survey shows (p. 52).

No one apparently has a solution to the problem. Facilities for training new engineers or technical aides are limited. One suggestion: Increase efficiency of every engineer 5 per cent, and the shortage of 40,000 engineers would be wiped out immediately.

The pipeline beat: Transcontinental Gas has FPC approval for its $53.7 million expansion. It'll add nearly 132 million cubic feet of gas daily to the system...Pipe experts say low-pressure polyethylene pipe will find increasing use in the oil country and reinforced plastic pipe will become competitive with steel in relatively high pressure applications...Texas Eastern has nearly completed work on converting the Little Big Inch from gas to products. ...Offshore producers are now talking privately about a big-inch crude line in the gulf to move their oil to shore.



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OIL AND GAS PIPELINES • REFINING • PETROCHEMICALS
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TECHNOLOGY—OPERATION

Drilling-Production

Liner Completions Make Low-Cost Duals in San Juan Gas Wells 77

By Ed McGhee

Some San Juan basin operators are running a liner below the intermediate string. Then, perforating a zone behind the intermediate string and a zone behind the liner makes a low-cost dual. This practice is one that could save money in other areas as well.

Field Processing—41: Design of Low-Pressure Gathering Systems 79

By Dr. John M. Campbell

Here are two figures and a table that offer a simple yet accurate solution for designing complex casing-head-gas systems where the system pressure does not exceed 50 psig.

Are Your Pumping Units Expensive to Operate? 84

By John Pickens

Better installation, operation, and maintenance of beam pumping units can often reduce cost of oil production. Here are some timely suggestions on how to get best service from pumping equipment.

Refining-Processing

Ethylene Oxide by the Direct Oxidation Process 80

By Peter W. Sherwood

Ethylene oxide accounts for the largest single use of ethylene. It takes about 30 per cent of the entire ethylene output. Most of the new capacity is based on direct oxidation of ethylene. This article summarizes the growth of this important process and points out possible future results.

On The Job . . . In The Plants 103

Combating pressure surges caused by rapid action of control valves—aluminum sheeting is being used for protecting insulation around pipelines, distillation towers, and other vessels at Shell's Anacortes, Wash., refinery.

The "H-Oil" Process Converts Refinery Residuals 109

By H. Pichler, M. Chervenak, C. A. Johnson, M. C. Sze, and J. F. Campagnolo

The "H-Oil" process reduces refinery residual stocks to the plant fuel requirement and converts the remainder into valuable distillate products. The process has flexibility to produce varying quantities of each distillate product.

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Report on Commercial Liquefaction of Natural Gas 97

By Peter B. Lederman and Brymer Williams

Liquefaction of natural gas at or near its source for transportation to fuel-poor areas is one of the most promising methods to be developed in recent years for the utilization of additional natural gas. Here is a complete report on the present status of this technique.

Pipelining

Pipeline-Flow Efficiency Testing—3 88

By R. F. Bukacek and R. T. Ellington

This final article in a three-part series is devoted to errors which may occur in testing pipeline-flow efficiency. Each possible error in measurement and the effect each has on the final result in considered in detail.

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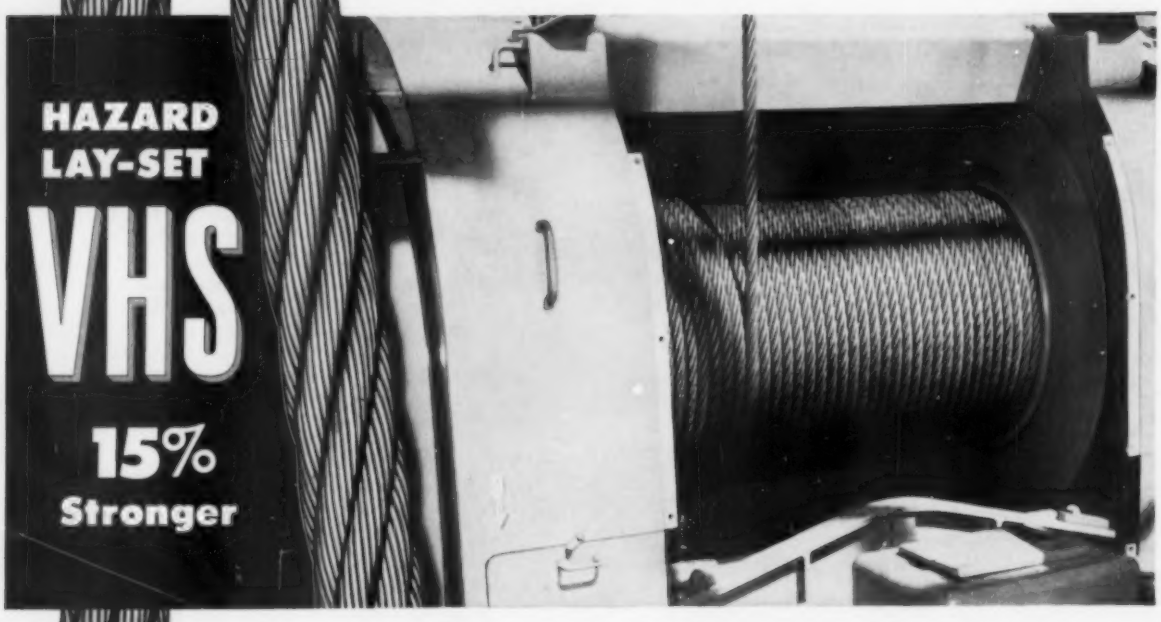

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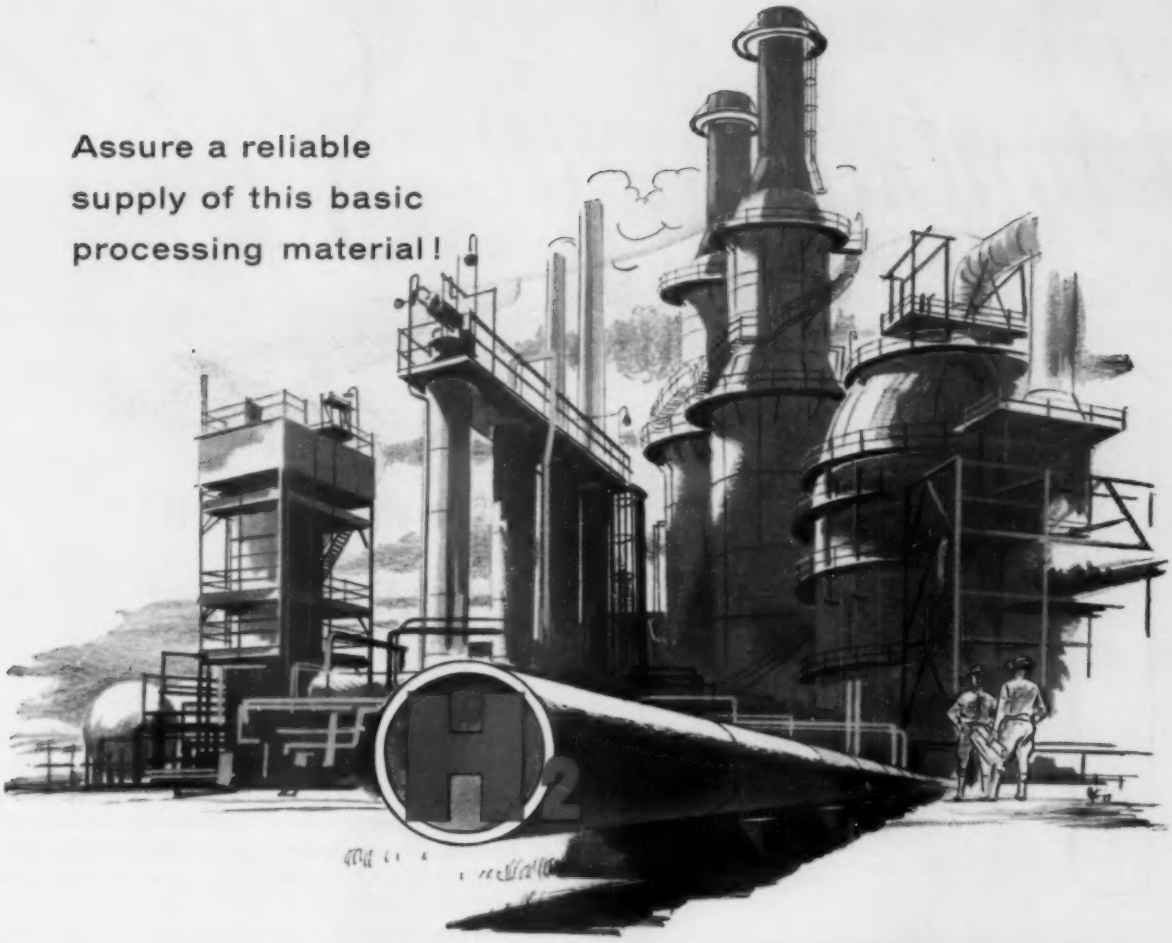

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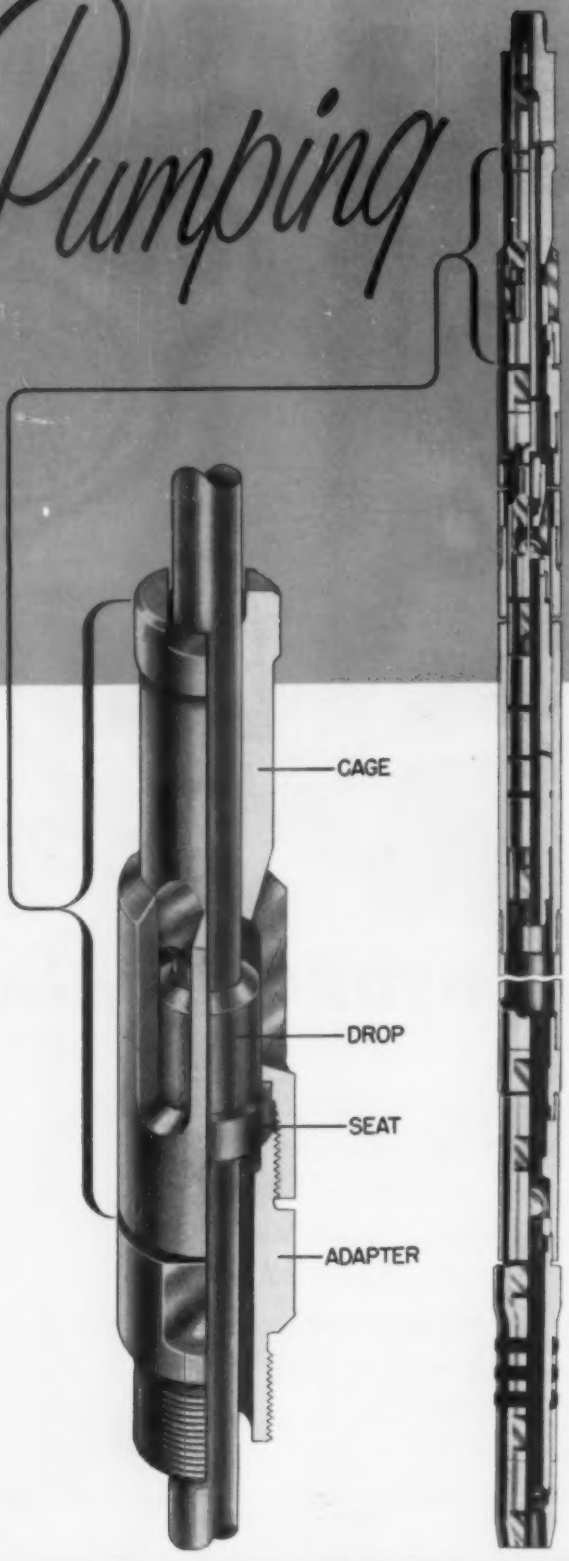

The Sand Check Cage is typical of the many quality features which make "Oilwell" subsurface pumps so outstanding. This cage is equipped with a drop valve which fits loosely around the valve rod. It rises on the upstroke of the plunger to permit the discharge fluid to wash away sand. It closes on each downstroke to prevent sand from settling in the pump barrel.

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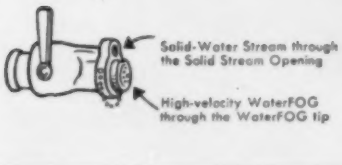

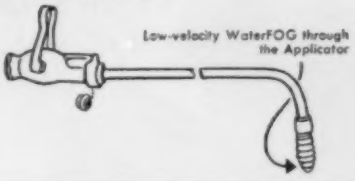

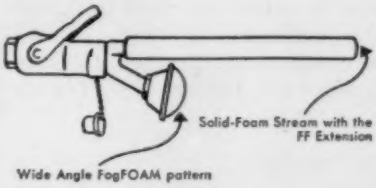

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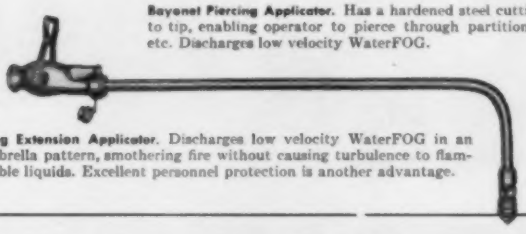
and here's the way to get more information

Bayonet Piercing Applicator. Has a hardened steel cutting tool attached to tip, enabling operator to pierce through partitions, into interiors, etc. Discharges low velocity WaterFOG.



Long Extension Applicator. Discharges low velocity WaterFOG in an umbrella pattern, smothering fire without causing turbulence to flammable liquids. Excellent personnel protection is another advantage.

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

Distributors in all principal industrial areas

ROCKWOOD SPRINKLER COMPANY

Portable Fire Protection Division
2064 Harlow Street
Worcester 5, Massachusetts

Please send me your illustrated booklet on Rockwood fire-fighting products.

Name .....
Title .....
Company .....
Street .....
City .....
Zone ..... *State* .....

How neoprene tanks slash costs for Dowell customers

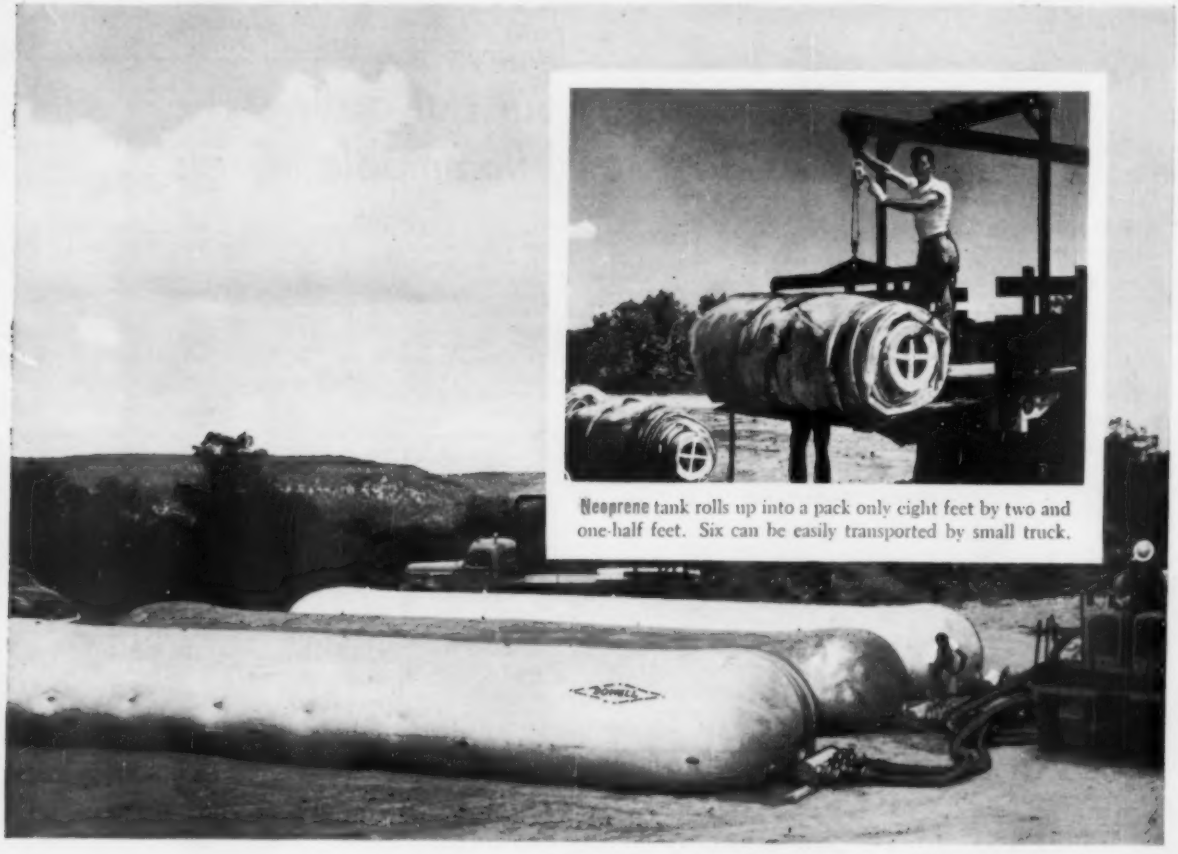
In the rugged San Juan Basin, Dowell, Incorporated, offers its customers collapsible storage tanks* made of nylon fabric, coated inside and out with Du Pont neoprene. By using these synthetic rubber tanks instead of steel tanks on well stimulation treatments, Dowell's customers are cutting transportation, handling and maintenance costs and saving vital time.

Each 15,000-gallon tank rolls up like a sleeping bag. Six can be carried on a small truck, for they weigh only 1350 pounds including fittings. When filled with water, crude or refined oils, they are 47 feet long, 10 feet 8 inches wide and 5 feet 3 inches high. The use of neoprene in these tanks is highly desirable because the rubber lining must resist oil and the cover must resist deterioration by sunlight, abrasion and rough handling.

Oil men around the world have found hundreds of uses for neoprene because of its unique combination of properties. It resists deterioration under the most adverse conditions because it withstands oil and corrosive chemicals, sunlight, heat, cold and aging.

Why not let neoprene save money for you? Next time you're buying piston rubbers, pipe wipers, rotary drilling hose or gaskets, specify NEOPRENE.

*PATENT PENDING



Neoprene tank rolls up into a pack only eight feet by two and one-half feet. Six can be easily transported by small truck.

NEOPRENE

MADE BY DU PONT FOR 25 YEARS

DU PONT

BETTER THINGS FOR BETTER LIVING
. . . through chemistry

AZTEC

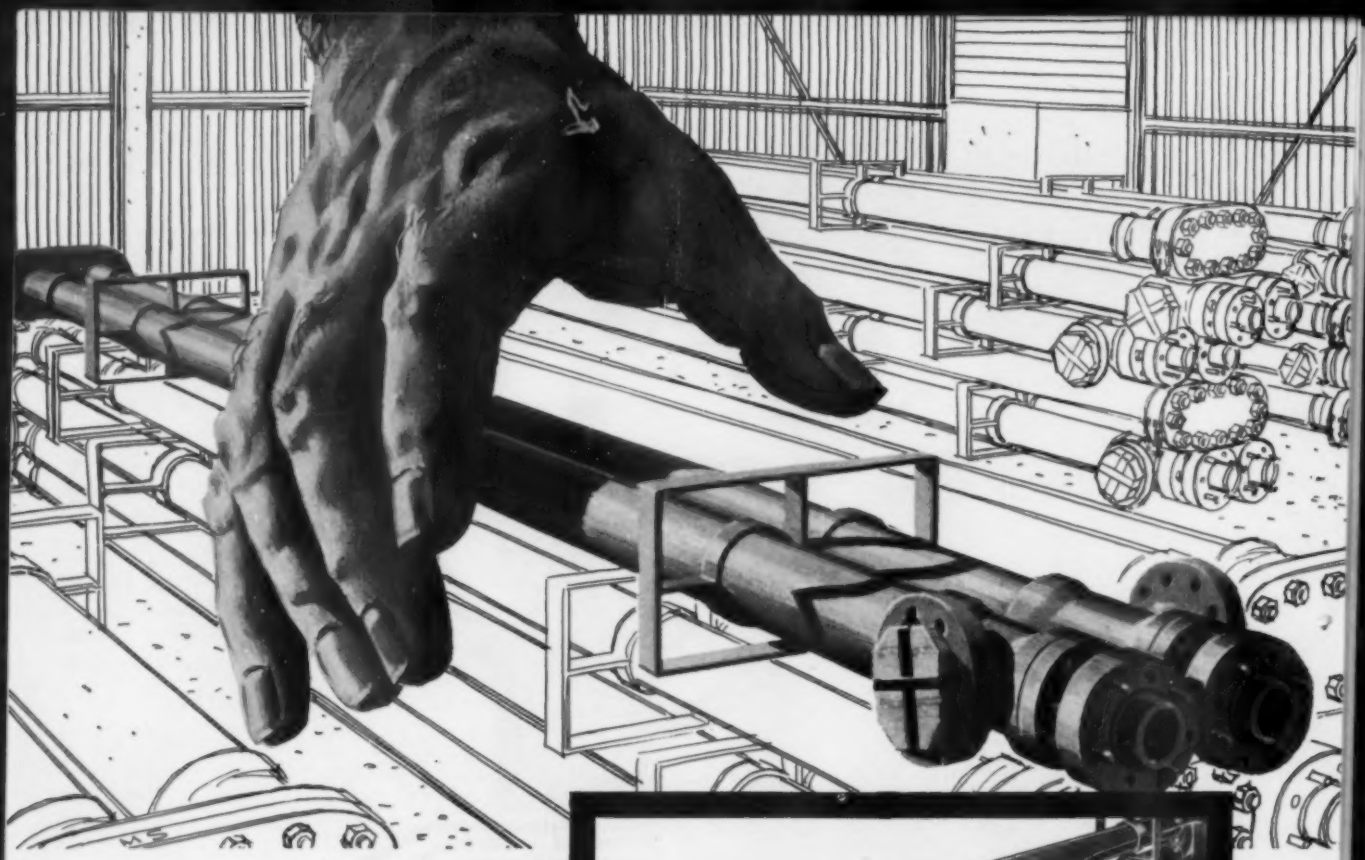
puts the indian sign on pumping costs

Backed by years of experience, Aztec has designed and built a new pumping unit to give you low cost pumping service for years to come We're rushing our expansion to make available a complete range of sizes. See Aztec pumping units in sizes up to 7000 pounds API polished rod load capacity at your favorite supply store now

AZTEC MANUFACTURING CO.

2901 W. Pafford Street
P. O. Box 11427
Fort Worth, Texas

Rigidly braced, four-legged Samson Post • Saddle and equalizer bearings are bronze bushings • Arc type hanger with vertical adjustment • Heavy cast iron slide rails • Herringbone gear reducer with positive bearing lubrication • Roller bearings designed for over 100,000 hours B-10 life



ALCOTWIN Heat Exchangers

Available from Stock Now

ALCOTWIN® heat exchangers are in stock in Beaumont for immediate delivery now. They are available in a number of sizes, for pressures up to 600 psi and temperatures to 650 F.

The flexibility of these "in-stock" ALCOTWINS gives them an unlimited range of uses. You can change load or processes within your plant and still use the same heat-exchange equipment. You can easily add new ones for increased load, or you can rearrange present ones for changing processes.

You select the exact ALCOTWIN for your job. The precise metallurgy needed for optimum results in your application can be selected on special order in an ALCOTWIN. The many combinations of tube and fin materials mean more efficient performance in high temperature services.

Complete information is available from any of ALCO's sales offices. For a copy of Bulletin FH-3, write Petroleum Industry Equipment Division, Dept. AW-2, P. O. Box 1065, Schenectady 1, N. Y.

ALCO

ALCO PRODUCTS, INC.

NEW YORK

Sales Offices in Principal Cities

Locomotives · Diesel Engines · Nuclear Reactors · Heat Exchangers · Springs · Steel Pipe · Forgings · Weldments · Oil-Field Equipment

GOODYEAR INDUSTRIAL PRODUCTS
GTM-Specified
Style WH Oil Suction & Discharge Hose (RB)
A
B
C
D
A Helix of flat, noncorroding, galvanized steel wire plus ply of heavy fabric coated with oil-resistant compound
B Tube of gasoline- and oil-resistant synthetic rubber
C Reinforcing plies of heavy fabric plus helix of round steel wire
D Oil-, age-, abrasion- and weather-resistant cover

Nearly three times the service—and still going strong!

Tankers are serviced very rapidly at this Texas dock. Standard operation is to load 138,000 barrels of gasoline in just 10 hours. Also standard is a test of the hose at periodic intervals to determine whether it can continue in service handling the highest test petroleum products or whether it should be relegated to low pressure, bunker or utility service.

Over eight years ago, the G.T.M.—Goodyear Technical Man—specified his Style WH Oil Suction and Discharge Hose for this service. At last report, this husky, 150-pound working pressure hose had repeatedly passed the high requirements of the exacting periodic tests and was well on its way toward delivering three times the expected service, handling gasoline, aviation gasoline, and solvents under high pressure.

If you're looking for the unusual in oil hose life, why not look up the G.T.M.? You'll find he carries a complete line of oil hose from which to specify the right types for your needs at lowest end cost. And he's readily available through your Goodyear Distributor or:

Goodyear, Industrial Products Division
Akron 16, Ohio

OIL SUCTION and DISCHARGE HOSE by

GOODYEAR

THE GREATEST NAME IN RUBBER

IT'S SMART TO DO BUSINESS *with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and nonrubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."*

J&L EXTREME LINE CASING

for deep wells

- High strength joint
- 100% leak resistant

J&L Extreme Line casing meets the challenge of your toughest deep well problems. Check the unusual advantages of this new J&L casing available in grades J-55, N-80 and P-110. Produced under license from The National Supply Co. Write to Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa.

High joint strength. A modified Acme-type (rectangular thread form) thread with a steep flank angle assures a strong interlock, takes tensional loads in shear.

100% leak resistant. Separate sealing surfaces lock together when two lengths of casing are joined. Seal consists of a curved surface extending beyond the male threads and a tapered conical seat beyond the inside end of the mating female threads. The number of threaded connections is halved.

J&L STEEL Jones & Laughlin ... a great name in steel

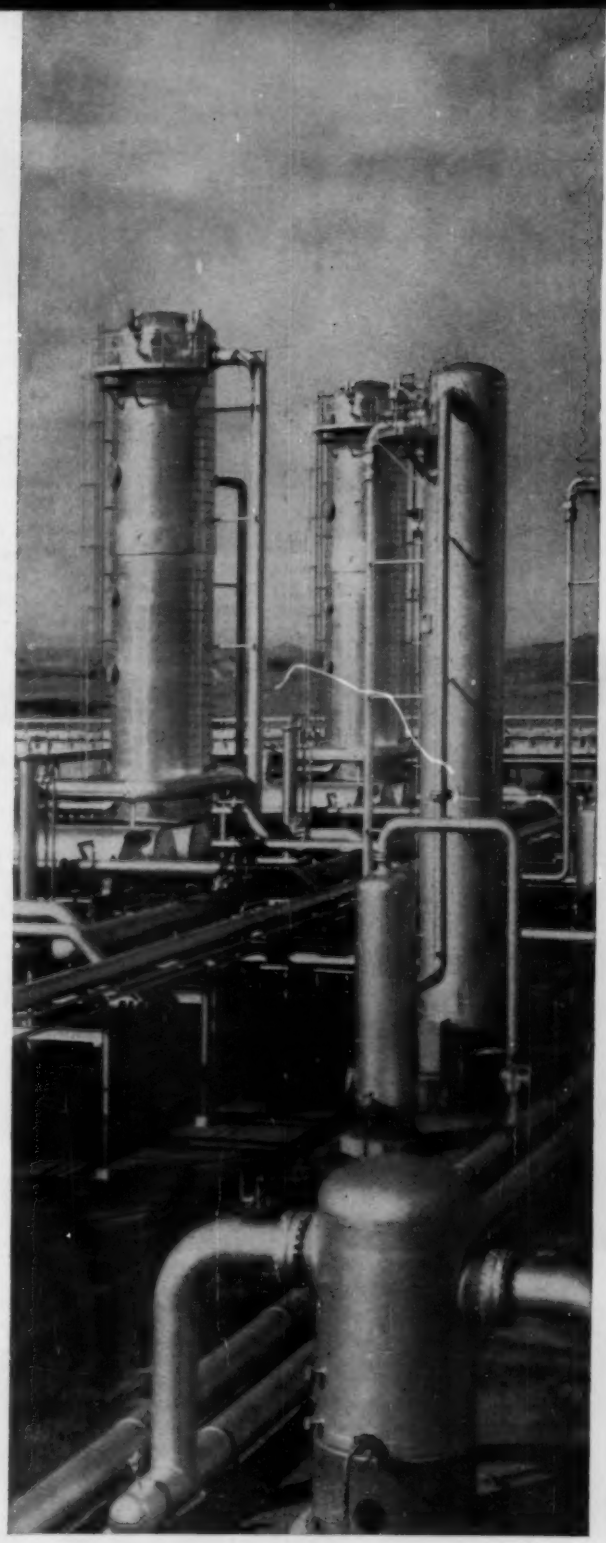
Performance-proved CURE for CORROSION HEADACHES

Specify Alcoa Aluminum for
• Process Equipment
• Transfer and Storage
• Plant Structures

Excessive maintenance and replacement of materials and equipment has fast become the biggest single headache in the process industries. Corrosion is far and away the most serious cause of such headaches. That's the big reason why aluminum—Alcoa® Aluminum—is daily being specified and installed in an increasing variety of uses throughout the process industries.

No other metal can match the ability of aluminum to resist successfully so many types of corrosive attack. And aluminum can be used to bring that unmatched corrosion resistance to a variety of applications . . . because only aluminum combines these *other* valuable properties in a single metal:

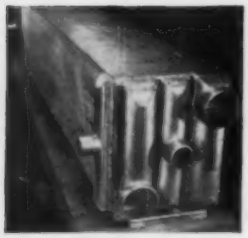
Light weight
Good workability
High thermal and electrical conductivity
Great strength in alloys
Nonmagnetic, nonsparking characteristics
Nontoxicity
Good reflectivity
Clean, attractive appearance
Low cost



Study the next three pages to discover a few of the many process industries' uses of Alcoa Aluminum which insure outstanding metal performance . . . unhampered by corrosion. See why these various uses of aluminum have already helped hundreds of others . . . and can help you!

ALUMINUM COMPANY OF AMERICA

This brazed aluminum assembly, weighing nearly 900 pounds, is typical of exchangers used in air separation plants and other low-temperature exchange processes.



A 105,000 sq ft surface condenser with Alcoa aluminum heat exchanger tubes.

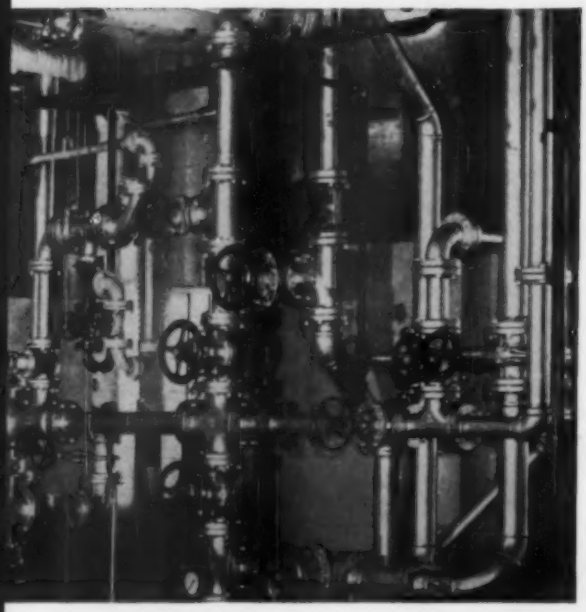
heat exchanger tubes

Aluminum heat exchanger tubes are low in cost, resist oxidation and other chemical attack, are easy to fabricate, have excellent thermal conductivity and freedom from embrittlement at low temperatures.

Aluminum tubes have demonstrated their ability to give long, dependable service under severe conditions. They are used extensively in exchangers for handling hydrogen peroxide, nitric acid, hydrogen sulfide, ammonia, naval stores, glycerine, scrylonitrile and other chemicals. Alclad tubes are recommended for use with natural cooling waters.

Aluminum costs approximately ½ the cost of admiralty, less than ⅓ the cost of stainless, and in the common ¾" and 1" sizes, less than mild steel.

Get detailed information on Alcoa aluminum heat exchanger tubes in booklet AD186, available on request.



Alcoa aluminum pipe proved ideal to solve corrosion and product contamination problems in this processing plant.

process piping

Corrosion resistant Alcoa aluminum pipe is widely used to carry liquids and gases in chemical, petrochemical, petroleum and food processing plants. It resists attack by the materials carried as well as by the corrosive atmosphere often encountered around such plants. And it prevents product contamination or discoloration.

Aluminum pipe is available in all of the normally produced schedules. It is by far the lowest priced corrosion resistant pipe available. For example, schedule 40 aluminum pipe is ¼ the cost of schedule 5 stainless, 1/7 the cost of schedule 40 stainless.

Write for *Aluminum Pipe and Fittings* booklet, AD197.

unitrace*

Alcoa now offers a new and improved design of Unitrace, the unique aluminum steam-traced pipe which incorporates the steam line as an integral part of the pipe. Extruded as a single unit of aluminum, from Alcoa 3003-F alloy, Unitrace is available in diameters equal to 1¼", 2", 3" and 4" pipe.

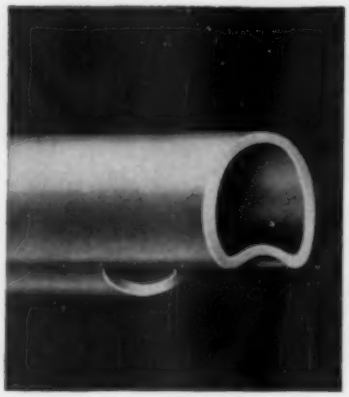
Special cast Unitrace flanges and fittings are available in alloy A356-T6 for efficient joining of sections. In many installations, flanging is not required, as sections of Unitrace can be joined easily by welding.

Preformed insulation will fit Unitrace although thermal insulation is unnecessary in many cases.

For detailed information, write for Bulletin AD418.

*Registered trademark

New type Unitrace section showing trace line cut back for joint. (Right) Special cast Unitrace flange for easy, efficient joining of new type Unitrace sections.



ALUMINUM COMPANY OF AMERICA

World's largest all-aluminum tank stands 26 feet high, has a diameter of 128 feet, holds 2½ million gallons of 83% ammonium nitrate solution.

Alcoa Standard Tanks provide storage economies for a wide variety of chemicals.

standard and special storage tanks

Alcoa standard storage tanks, fabricated of 3003 alloy, are supplied in sizes ranging from 5,800 to 21,400 gallons. Both horizontal and vertical construction are available.

Made from stocked components, these standard tanks bring the user all the advantages of Alcoa Aluminum at lower cost, with faster delivery.

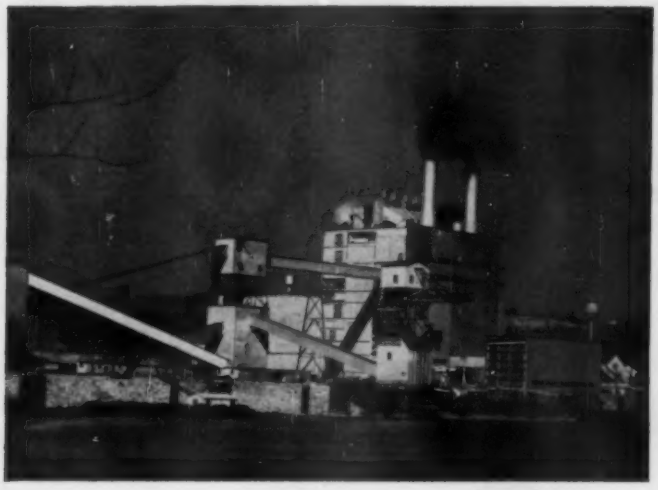
Storage tanks to meet many special requirements may be constructed of Alcoa sheet and plate. Information on design and fabrication will be furnished on request. Write for *Alcoa Standard Storage Tanks* Bulletin, AD387.

shipping containers

Alcoa offers a wide variety of shipping containers conforming to ICC regulations. Ranging in size from 7½ to 110 gallons, they are used to ship such diverse products as beer and fuming nitric acid.

Alcoa aluminum containers are lighter in weight than containers of other suitable materials, are less expensive and give longer service.

roofing, siding, structurals and paint



Alcoa industrial building sheet is used for roofing and siding on plant buildings and to protect conveyors and other outdoor equipment. The aluminum surface requires practically no maintenance and lasts well even when exposed to corrosive atmospheres often encountered around processing areas. It is easily installed and helps to keep construction costs low.

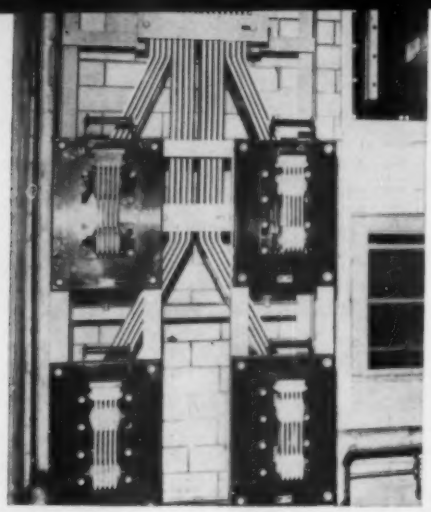
Alcoa also supplies structural shapes for use in construction where their corrosion resistance and consequent low maintenance cost are advantageous.

Paints pigmented with Alcoa Aluminum provide a continuous metallic sheet of pure aluminum for unmatched protective power.

Write for *Alcoa Industrial Building Products* booklet, AD285, *Alcoa Sandwich Walls* booklet, AD625, or *Painting With Aluminum* booklet, AD228.

Aluminum exterior surfaces for buildings and conveyors provide pleasing appearance with minimum maintenance.

ALUMINUM COMPANY OF AMERICA



bus bars

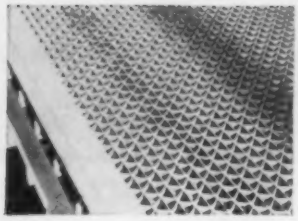
Lowest cost per unit current capacity and good corrosion resistance are key advantages for aluminum bus bars in process plants. Write for Alcoa Bus Conductor Handbook, AD661.

grating and tread plate

New grating-type Alcoa aluminum stair treads require no paint . . . are available in all standard sizes at a price competitive with galvanized steel and abrasive nosing. (Write for Bulletin AD679.)

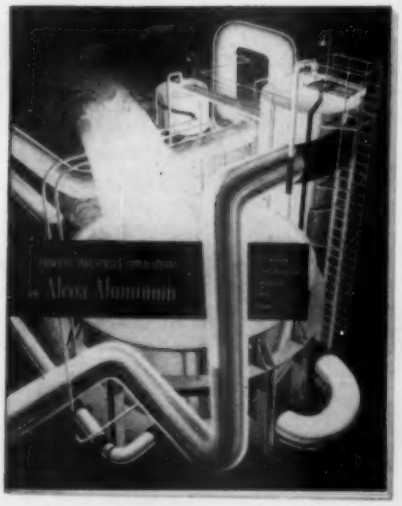
Aluminum grating is used widely for floors and walkways in and around processing plants because of its light weight, resistance to corrosion, low maintenance and nonsparking characteristics.

Alcoa supplies both a standard aluminum tread plate and Alcoa Abrasive Tread Plate. The latter has a self-renewing, bonded abrasive surface for extra nonskid protection. (Write for Bulletin AD596.)



this free book

. . . can be your dependable guide to solving corrosion problems in the process industries. Send for it now. Its 80 pages are filled with definitive data on the behavior of aluminum with specific materials . . . along with detailed design and specification information. Your copy will be sent promptly. Ask for Process Industries Book, AD460.



use Alcoa engineering assistance to solve your corrosion problems

In the course of many years' study of corrosion problems, Alcoa has acquired an immense fund of practical, nonconfidential information on corrosion characteristics of many materials and processes under various conditions. This information is available to you without obligation. Simply write Alcoa.

To insure receiving the most useful information, state your problem as specifically as possible. Alcoa's development engineers will then supply and help you evaluate the best available information.

Alcoa is also prepared to undertake cooperative testing programs in certain cases where existing data is insufficient. Contact your nearest Alcoa sales office for details.

Aluminum Company of America
904-J Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature (see above for booklet nos.):

_____

_____

_____

Name _____

Company _____ Title _____

Address _____

City _____ Zone _____ State _____

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

are you pumping red tape?

If you are there's no quick, easy solution to your problem. But an answer must be found. The red tape of oil operation can choke production as surely as a well that is sanding up. These higher operation costs can cut your profit to the point that you are working only for your creditors.

Although you have no control over your sales price, you can control your costs. Working with your legal and tax counsel, The Commerce can analyze your costs, find where economies can be effected, thereby increasing the profitableness of your operation by helping you to cut your costs. Your income goes up when you stop pumping red tape.

Facilities of The National Bank of Commerce Oil Loan Department are available in Wyoming, Nebraska, Colorado, New Mexico, Texas, Louisiana, and Mississippi.

E. O. Buck, vice president, Oil Loan Department

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

THE NATIONAL BANK OF

COMMERCE

OF HOUSTON

Gulf Building, Houston, Texas

3 More New Rigs Get General Electric Drive for Land, Offshore Drilling

More and more rigs for both land and offshore applications are being specifically designed for electrified oil well drilling with General Electric drive systems. Here are just a few of the reasons why:

- Designed-in control simplicity of G-E drive eliminates complicated external apparatus, feed back systems, and torque limiting devices.
- General Electric drive gives you greatly increased flexibility. Fewer parts to service mean less maintenance time and expense.
- You can use General Electric drive with virtually any popular oil field engine. G-E drive is at least 85% efficient and helps eliminate mechanical drive losses.
- General Electric drive is available for a wide range of applications, including all normal drilling functions on land or offshore.

Like the operators of the three rigs described on your right, you, too, can obtain these benefits from a General Electric Drive System.

For more information, call your nearest General Electric Apparatus Sales Office or your International General Electric Sales Office. (Principal drilling offices in Dallas, Houston, New Orleans, Denver, Tulsa, and Los Angeles; Bogota, Maracaibo, Caracas, Buenos Aires, and New York.) General Electric Company, Locomotive and Car Equipment Department, Erie, Pa. 115-23

Progress Is Our Most Important Product

GENERAL ELECTRIC

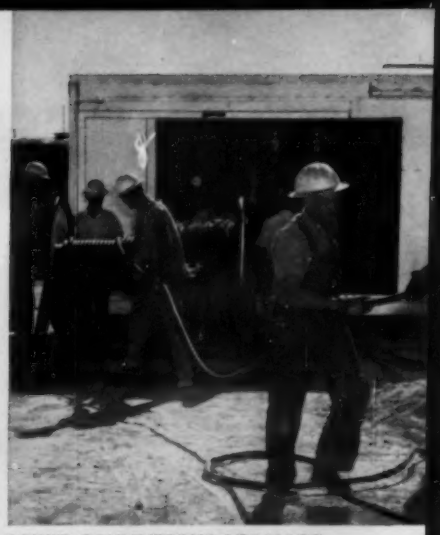
1 **GREAT WESTERN RIG NO. 44,** equipped with a General Electric S-343 drilling rig package, is now drilling what may become the world's deepest hole for Phillips Petroleum Co. near Ft. Stockton, Texas.

2 **PENROD DRILLING COMPANY'S JIM WOODRUFF BARGE NO. 51,** designed to drill in 70 feet of open water. G-E B574 drive system includes five G-E generators and seven drilling motors.

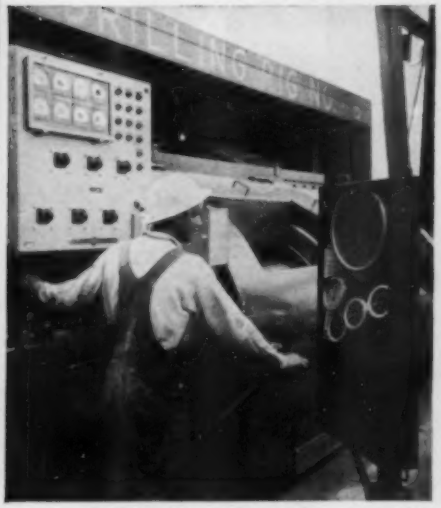
3 **CREOLE PETROLEUM BARGE NO. C228** is fitted with G-E drive components. Built to serve fixed or mobile platform, C228 has G-E B6743 drive system, White-Superior PTD-E8 diesels.

READY TO DRILL WITHIN 1½ DAYS, rapid rig-up was made possible by the portability of a G-E electric drive. Above, drawworks near derrick floor.

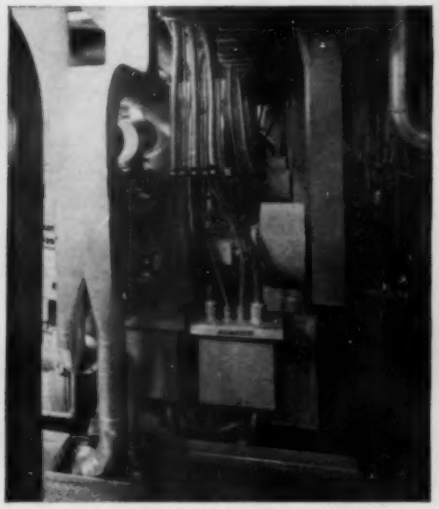
INCREASED FLEXIBILITY was gained with the use of G-E drive. Power skids with Cummins LRT-600 TURBODIESEL engines, G-E generators can be located "practically anywhere."



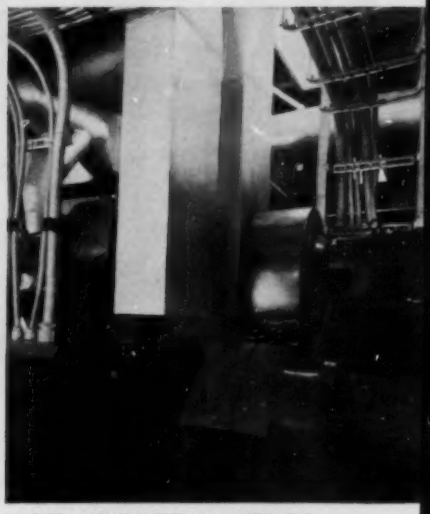
POWER CONNECTIONS ARE MADE QUICKLY with flexible cables, helping Great Western Drilling Company to speed operations.



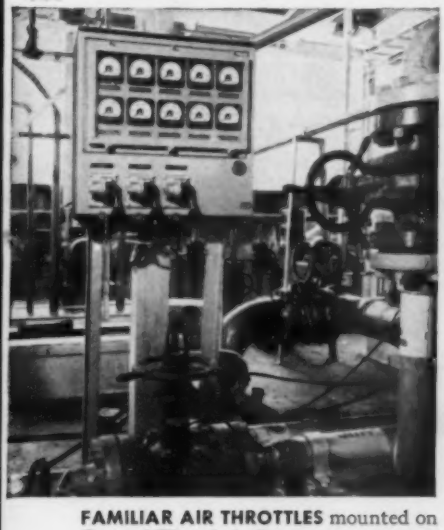
COMPACT G-E DRILLER'S CONSOLE gives operator better control of all electrically driven functions. Indicating ammeters, voltmeters are easy to read.



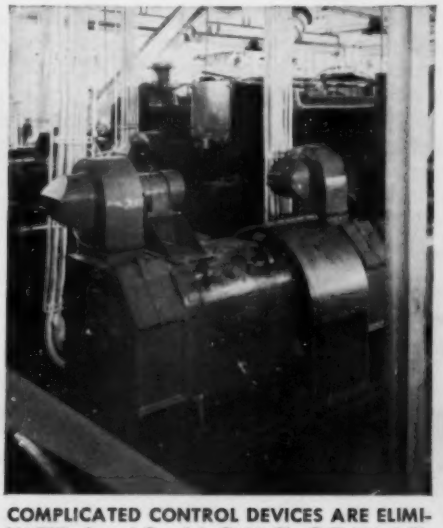
G-E 752J GENERATORS MATE PERFECTLY with Cat. D397 engines to produce reliable electrical power. Generators are reliable, easy to maintain, and have long life features.



EASIER EQUIPMENT SERVICING is made possible with G-E drive because power connections are flexible, can be easily broken.



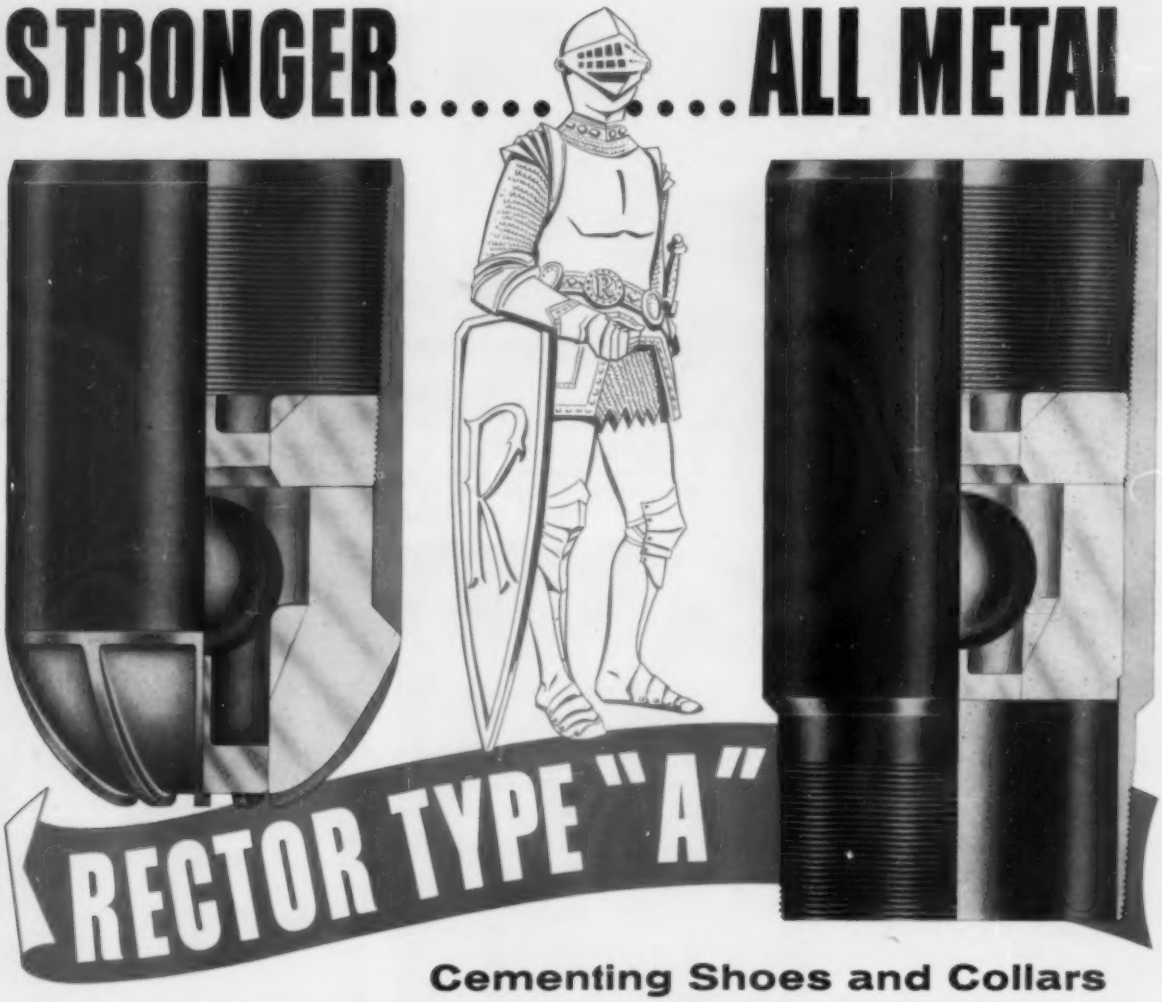
FAMILIAR AIR THROTTLES mounted on General Electric-built pump room operator's console permit fast, accurate pump control.



COMPLICATED CONTROL DEVICES ARE ELIMINATED aboard Creole's C228. Six G-E 752 drilling generators and seven G-E 752H motors have "built-in" control, protection features.

CONTROL DEVICES ARE EASY TO SERVICE. Main d-c control cabinet has only simple contactors, relays, resistors and air valves.

STRONGER.....ALL METAL



RECTOR TYPE "A"

Cementing Shoes and Collars

Precision made for a good cementing job every time!

Rector Type "A" Shoes and Collars are precision machined from high quality seamless steel with internal parts of a special high strength ALUMINUM ALLOY that is readily DRILLABLE. Not only is the ALUMINUM ALLOY far stronger than concrete or bakelite, but is machinable to close tolerances for precision fabrication.

Internal parts are quickly drillable, as there is a minimum of material to be drilled out.

Bullet nose permits the shoe to guide smoothly past ledges and obstructions.

For economical, trouble-free cement jobs, always ask for Rector Type "A" equipment at your favorite SUPPLY STORE.

Stocked by supply stores in casing sizes 4½" O.D. to 13⅜" O.D.

EXPORT DISTRIBUTORS:
Continental Supply Company
Mid-Continent Supply Company
Oil Well Supply Company

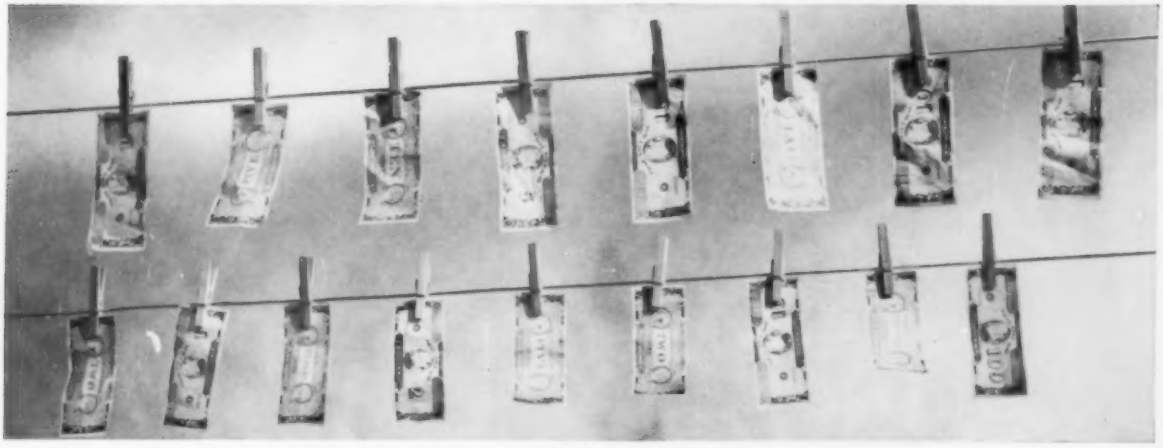
RECTOR WELL EQUIPMENT COMPANY INC

★ MAKING THE OIL INDUSTRY SAFER

1100 NORTH COMMERCE ST. FORT WORTH, TEXAS
Houston Plant: 2215 Commerce St.
REPRESENTATIVES IN ALL ACTIVE FIELDS

How your telephone wires

can work harder . . .



and save you real money!

LENKURT TYPE 33A CARRIER *is a low-cost answer to increasing circuit capacity for small to medium-sized pipelines and refineries. As exclusive distributor for Lenkurt equipment, Automatic Electric offers complete engineering and installation service.*

See Automatic Electric for expert help in getting maximum value out of your big investment in telephone lines. With Lenkurt Carrier equipment, our engineers can increase your present circuit capacity up to 20 times or more . . . using your present wires!

Example: an economical Lenkurt Carrier installation can provide, *on a single voice channel*, new circuits for over 100 remote control and operating functions! And, with Lenkurt equipment, Automatic Electric can expand your present communications to include a private dial telephone system to expedite all inside calls throughout your entire organization.

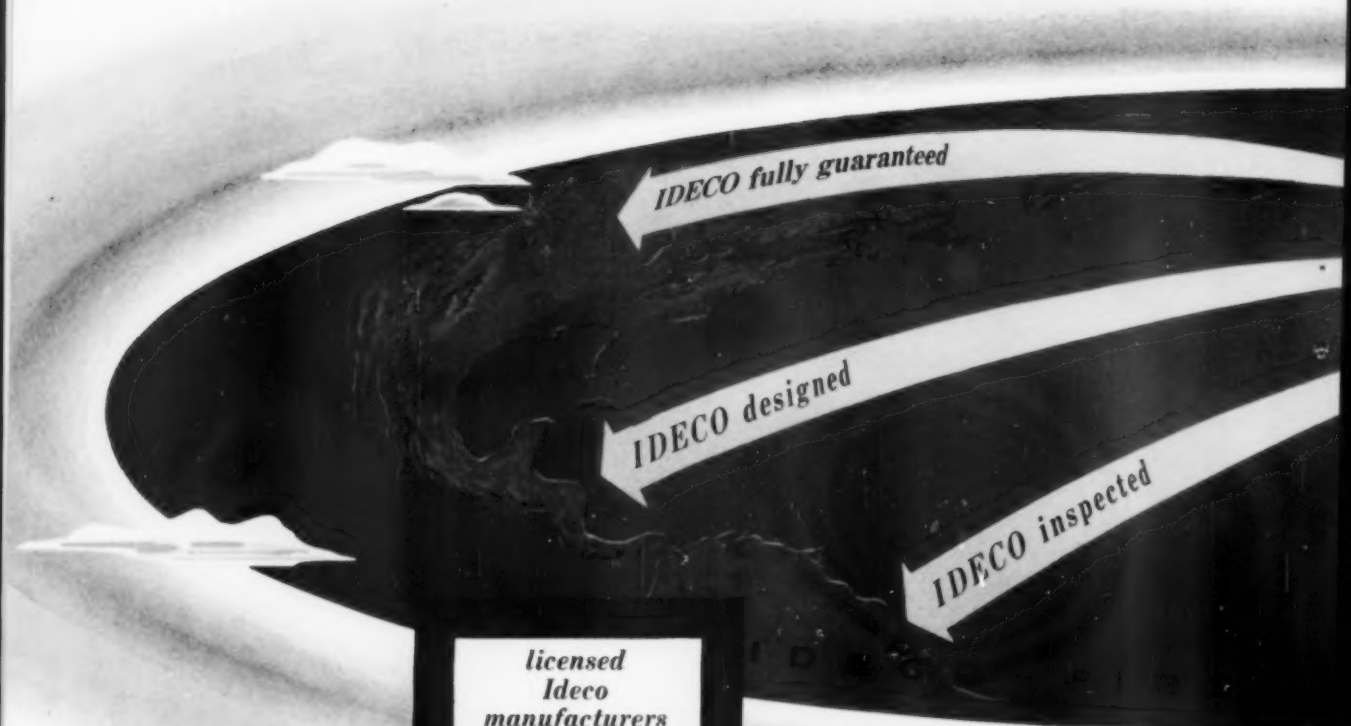
This adds up to real efficiency—and real economy. You'll find Automatic Electric's specialized experience—gained in serving dozens of oil companies—can be mighty helpful in solving your communications problems. We'd like to tell you the whole story. Just write Automatic Electric Sales Corporation, Northlake, Ill.

AUTOMATIC ELECTRIC

A member of the General Telephone System—
One of America's great communications systems

GENERAL TELEPHONE SYSTEM

Now Buy IDECO® Rigs



licensed Ideco manufacturers abroad

England

WOODFIELD HOIST

Italy

NUOVO PIGNONE

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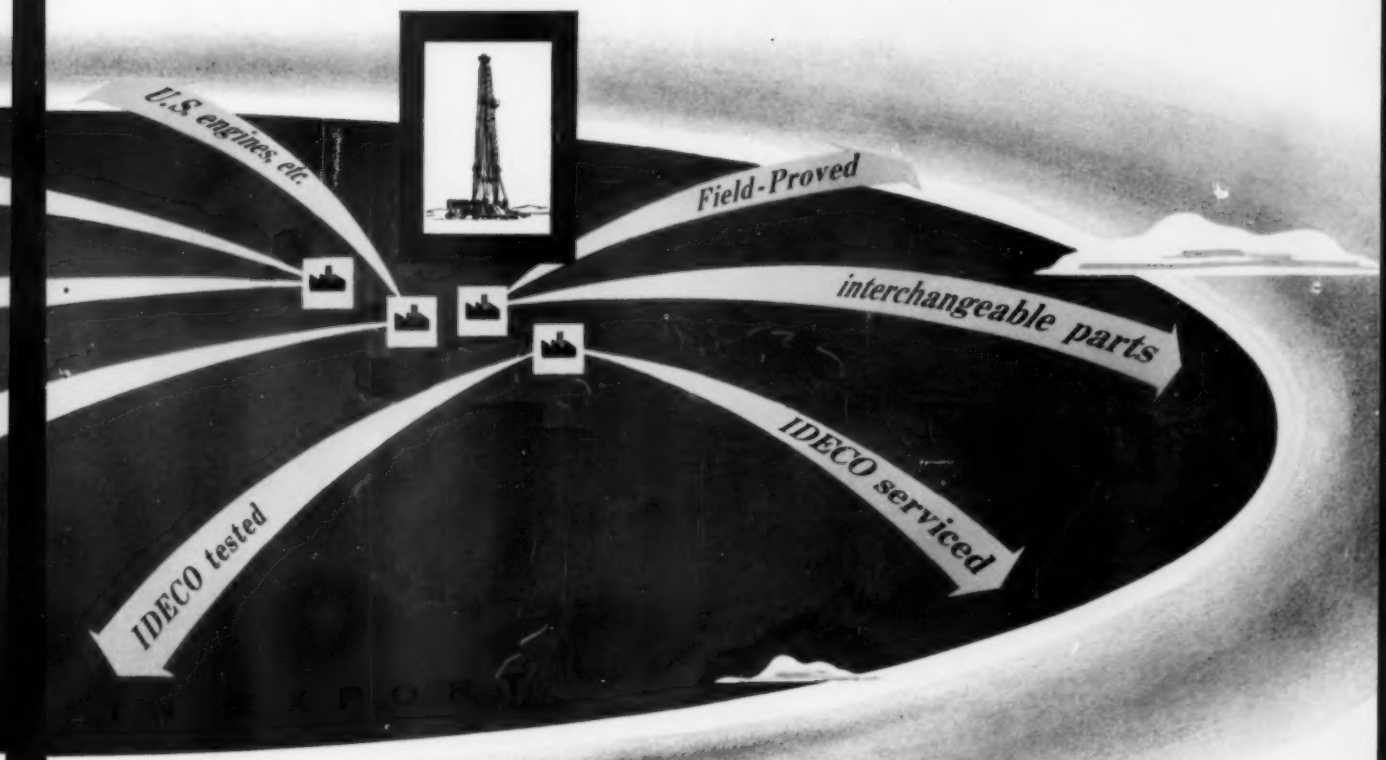
HIGHEST U.S.A. QUALITY.

4 MANUFACTURERS

YOUR CHOICE OF CURRENCY

Five years ago Ideco launched a program, through its European affiliate Dresser A. G., to make it more convenient for drillers the world over to buy the equipment of their choice with the currency of their choice. Now, four outstanding European manufacturers are licensed to furnish you complete drilling equipment – designed, inspected, tested, serviced and fully guaranteed by Ideco. The quality is the same that made Ideco foremost in the export field. Many components are actually made in the United States. All components are completely interchangeable with other Ideco equipment. Think what this means to your foreign operations – equipment you *know* is tops – replacement parts close at hand – soft currency purchases – guaranteed performance! To get the full story, include an Ideco proposal in your plans.

... Made in Europe!



. available for soft currency!

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HEADQUARTERS — 31st Floor, Republic National Bank Building, P. O. Box 1331, Dallas 21, Texas — Telephone RIverside 1-1031, Cable IDECO.

MAIN PLANT, U.S.A. — 1800 Laurel Ave., Beaumont, Texas.

LICENSED MANUFACTURERS — *Austria:* Schoeller-Bleckmann Steelworks, Vienna; *England:* Woodfield Hoist, Rochester, Kent; *France:* Batignolles-Chatillon, Paris; *Italy:* Nuovo Pignone, Florence.

EXPORT OFFICES — Dallas and Houston, Texas; New York City, New York; Long Beach, California; London (Ideco-Woodfield), England; Paris, France; Rome, Italy; Rio de Janeiro, Brazil; Edmonton, Alberta, Canada; Mexico, D. F., Mexico.

CALIFORNIA OILFIELD SALES — Ideco, Inc., Long Beach, California.

LATIN AMERICA — Sales Representative, Dresser International, Inc. — *Argentina:* Buenos Aires; *Brazil:* Rio de Janeiro; *Mexico:* Mexico, D. F.; *Peru:* Lima; *Venezuela and Colombia:* (A-Z Export, representative) Maricaibo, Puerto la Cruz, Bogota; *Trinidad:* San Fernando.

EASTERN HEMISPHERE — Sales Representative, Dresser A. G. — *Austria:* Vienna; *Egypt and Middle East:* Lebanon, Beirut; *France:* Paris; *Germany:* Hannover; *India:* New Delhi; *Italy:* Rome; *North Africa:* Algeria, Algiers; *Spain:* Madrid; *Turkey:* Istanbul; *United Kingdom and Holland:* London (Ideco-Woodfield); *Yugoslavia:* Belgrade.

When only the best will do... use

IDECO

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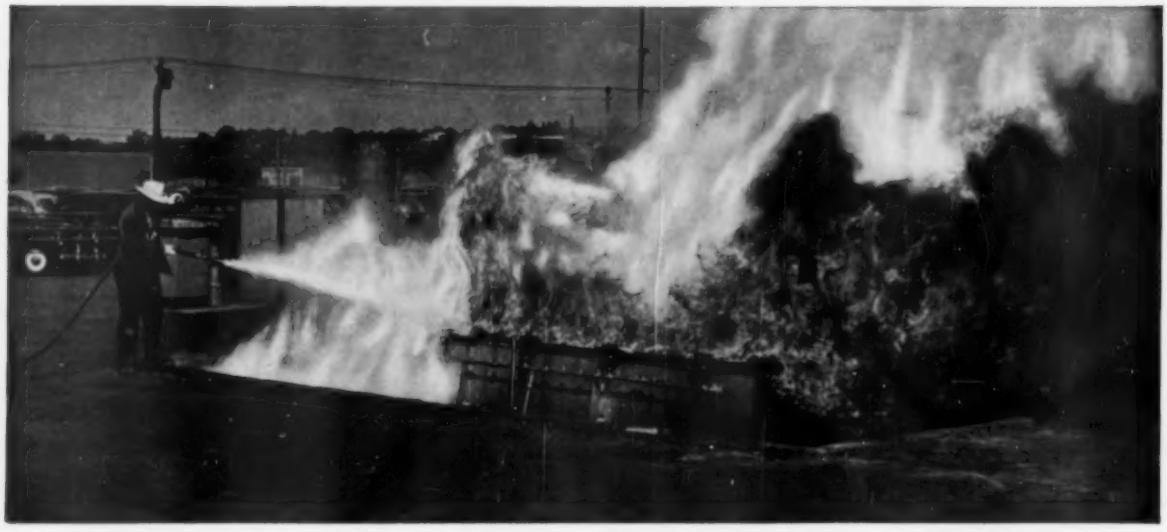
SUDDEN DEATH TO OIL FIRES!



Kidde wheeled units make short work of any blaze!

"One-man fire engines" are what some people call Kidde mobile fire extinguishing units . . . and with good reason! With one or two Kidde mobile units near large-scale fire hazards, there's no waiting fretfully for the fire department when fire strikes . . . you *are* the fire department!

Especially effective in fighting fires in oil, gasoline or other flammable liquids, Kidde *dry chemical* wheeled units have an on-off control *at the nozzle* (for easier operation) will give either "straight" or "fan" pattern for greater range or wider coverage. Designed for fast, easy maneuvering, Kidde *indoor* dry chemical "fire engines" pass readily through doorways with no costly waste motion, while *outdoor* models have wider-faced wheels for faster action on soft ground surfaces.

Kidde mobile fire extinguishing units are also available in CO_2 and foam types – illustrated and described below. For more information, call your nearest Kidde agent (he's in the yellow pages) or write today for Kidde's P-8 catalog.

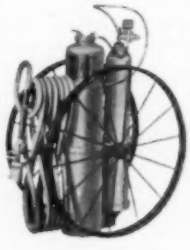
40-GALLON FOAM UNITS

Ideal protection against flammable liquid fires, delivering more than ten times its tank capacity in fire-smothering foam. 50 feet of hose, 50-60 foot effective range.

CO_2 WHEELED UNITS

Available in 50, 75 and 100-pound single-cylinder capacities. Shut-off valve located at nozzle gives operator complete control. Especially good indoors since CO_2 gas leaves no mess to clean up after a fire.

150-POUND DRY CHEMICAL UNITS



Single-lever control for "on," "off," "fan" or "straight" discharge pattern. 30-40 foot range on straight discharge. 50 feet of hose. Easily handled by inexperienced operator.

Kidde

Walter Kidde & Company, Inc., 955 Main Street, Belleville 9, N. J.

Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

SERVING *Oil* TRANSPORT

Seventy years of experience back up MANNESMANN's reputation as a leading maker of high-quality seamless pipe to API standards for oil transport and for other uses in all industries throughout the world. This same experience is built into every pipe leaving our new automatic seamless pipe mill at Sault Ste. Marie, Ontario. Its main products are seamless casing and line pipe from 4½" to 10¾" O.D. for the ever-growing oil industry.

MANNESMANN TUBE COMPANY LTD.

SAULT STE. MARIE, ONT., CANADA

Associated Sales Offices

CANADIAN MANNEX CORPORATION LIMITED 3808-7th Street East, Calgary, Alberta

AMERICAN MANNEX CORPORATION 233 Broadway, New York 7, N.Y., and 713 Texas National Bank Building, Houston, Texas

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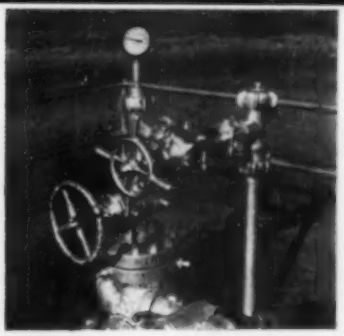
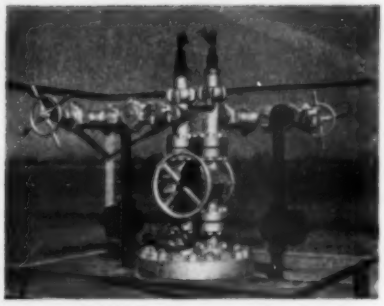




Nice thing about UNIBOLT Flow Manifolds . . .

you buy only what your well needs, and no more

Since well conditions and completion methods differ widely, no one Christmas tree flow control of the "fixed design" type can possibly serve all wells efficiently. Not so with UNIBOLT Flow Manifolds, the components of which may be readily arranged in any design to exactly fit well requirements.

These flexible Flow Manifolds, composed of standard UNIBOLT Tees, Crosses, Adjustable Wing Valves or Chokes, can be combined in a dozen different ways. Thus, you buy exactly what is needed for a given well.

And the entire manifold may be salvaged as a unit or in separate parts for later use in other manifolds.

From the lightest screwed manifold to the heaviest high-pressure assemblies and corrosion-resistant steel, UNIBOLT Flow Manifolds can be tailored to your needs. You save steel and, at the same time, you hold capital investment to a minimum.

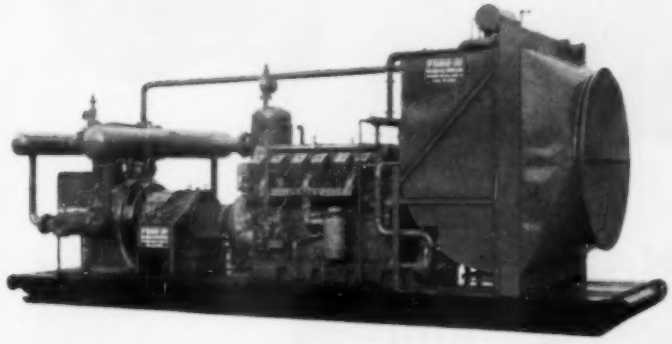
THORNHILL CRAVER CO.
P. O. BOX 1184 HOUSTON, TEXAS

McNAMAR - JOY

GAS COMPRESSORS

This unit, packaged by McNamar Boiler and Tank Company, is operating in California, boosting gas from 100 psig suction to 400 psig discharge. Capacity 4.5 MMCFD.

The cooler, fabricated by McNamar, cools the engine and compressor jacket water and after cools the gas to 130°. The unit, mounted on a skid 8 ft. wide x 32 ft. long, weighs 45,000#. Only the suction and discharge connections are necessary to place into service upon delivery.



- VERSATILE
- COMPACT
- PORTABLE

Find out how McNamar-Joy Gas Compressors can be engineered to your gas boosting needs. Units are available in 50, 100, 200 and 400 horsepower. Send this coupon today and McNamar will mail to you bulletins with complete technical details — also information regarding purchase, rental or rental-purchase options.

McNamar Boiler and Tank Company
P. O. Box 868
Tulsa 1, Oklahoma

Please send bulletins on McNamar-Joy Gas Compressors.

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Company_____

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McNAMAR BOILER & TANK CO.

BOX 868 — TULSA, OKLAHOMA

McNAMAR TULSA

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WITH HALLIBURTON
tools and techniques

When weak and unconsolidated formations break down from high pressure surges or heavy columns of well fluid, get scientific reduction of these problems through the use of Halliburton Cementing Services.

Halliburton has been effectively dealing with weak formations since the Earlsboro, Oklahoma oil field was discovered in 1924, and this extensive experience of several million cementing jobs has instilled an extra alertness and understanding of weak formation difficulties. Supplementing this unrivalled background is an industry-approved combination of special weak formation tools and products which help prevent problems before they arise.

Specify Halliburton cementing and take advantage of this unmatched "know-how" in securing maximum benefits for your wells.

HALLIBURTON
OIL WELL CEMENTING COMPANY
DUNCAN, OKLAHOMA

protect weak formations better with a combination of Halliburton products

SELF-FILL DIFFERENTIAL COLLAR

New! SELF-FILL DIFFERENTIAL COLLAR

Just one of these new tools, placed in the casing string above a Super Seal Float Shoe or top Float Collar, allows well fluids to fill the casing automatically as it is lowered into the well. It is highly efficient in the deepest drilled wells, even when drilling mud contains a high percentage of cuttings and lost circulation materials. New features help provide an extra margin of protection from the danger of blowout... plus greater protection for weak formations, and reduced running-in time for casing... make Halliburton's new Self-Fill Differential Collar an extremely dependable and versatile automatic fill-up device. The very low differential pressure (only 80 psi) between annulus and inside of the casing helps reduce blowout danger and possibility of formation damage caused by "ram-effect". Get full details on this unique new product from your Halliburton representative.

HALLIBURTON CEMENT BASKET

CEMENT BASKET...

Used to protect weak formations and retain cement by reducing possibility of formation breakdown and loss of slurry. Run on outside of casing or liner at point above weak or porous formations, basket provides a bridge to help support cement column. Often used below Halliburton's "DV" Multiple Stage Cementer in stage cementing.

ADMIX SAFETY FLOAT SHOE

ADMIX SAFETY FLOATING EQUIPMENT...

Protection of weak formations or lost circulation problems have required the use of Flocele, Howcogel or other additives in drilling mud or cement. Unlike most conventional floating equipment, Admix Safety Float Collars and Float Shoes incorporate specially engineered Safety Plugs which pump out at pre-determined pressures if they become plugged with cuttings or lost circulation materials. This minimizes the danger of leaving the casing filled with cement containing admixtures.

FLOCELE...

Helps prevent and reduce the loss of cement into weak, permeable formations by sealing off these formations. Added to the cement slurry, Flocele is a chemically inert cellulose film flake which does not affect the pumping or setting properties of cements. Very economical, since only ¼ to 1% of Flocele is usually sufficient.

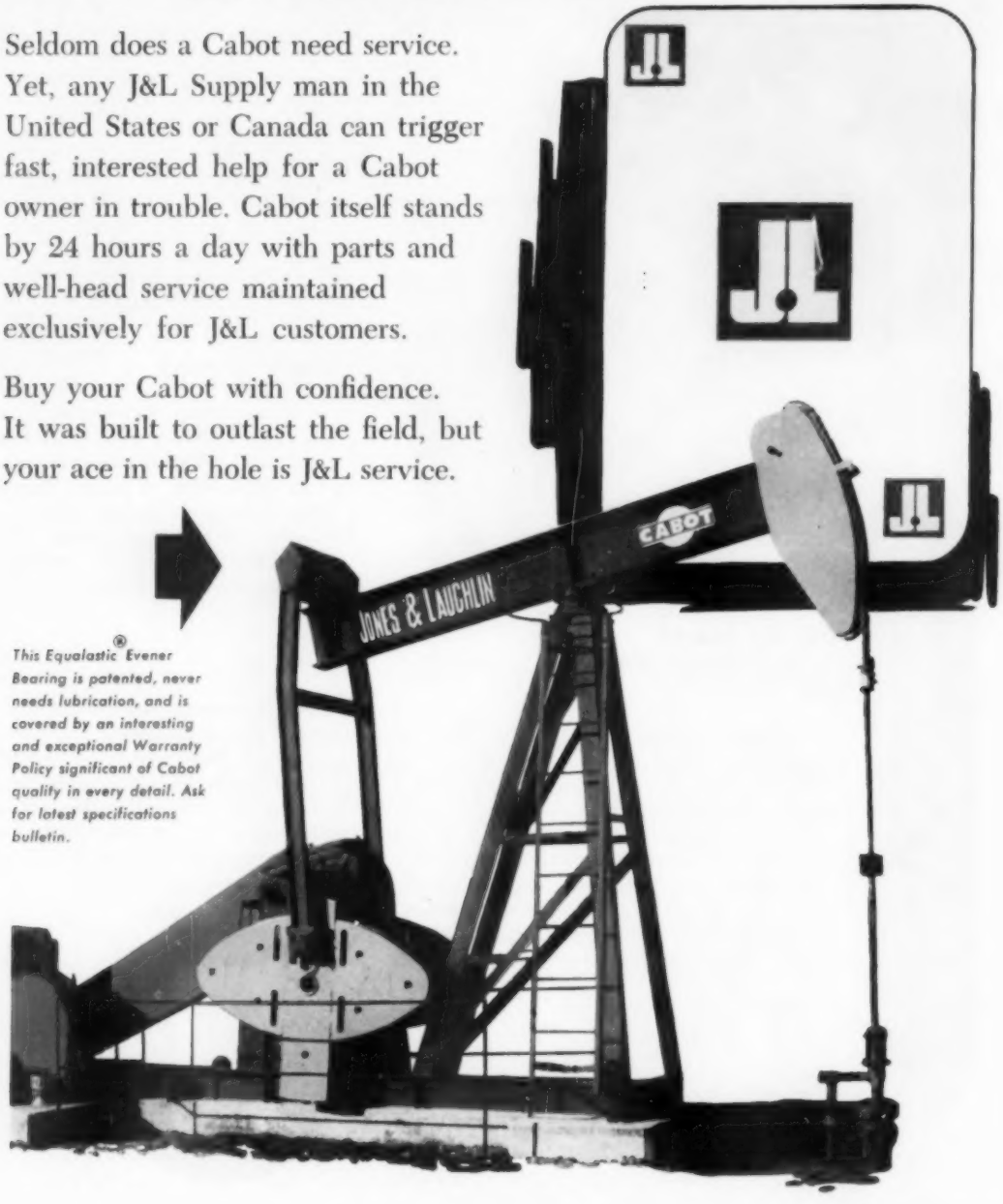
CEMENTING SERVICES

251 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY WELL

ACE IN THE HOLE for CABOT owners

Seldom does a Cabot need service. Yet, any J&L Supply man in the United States or Canada can trigger fast, interested help for a Cabot owner in trouble. Cabot itself stands by 24 hours a day with parts and well-head service maintained exclusively for J&L customers.

Buy your Cabot with confidence. It was built to outlast the field, but your ace in the hole is J&L service.



This Equalastic® Evener Bearing is patented, never needs lubrication, and is covered by an interesting and exceptional Warranty Policy significant of Cabot quality in every detail. Ask for latest specifications bulletin.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

J&L — A GREAT NAME IN SUPPLIES

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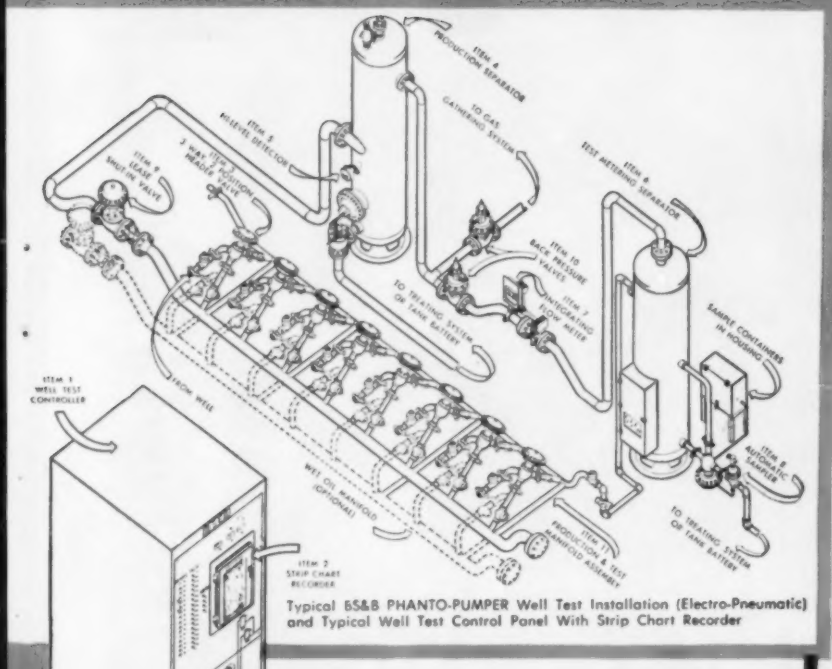
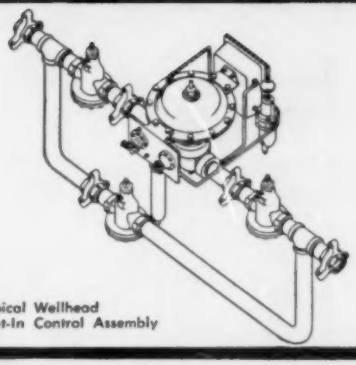
"BS&B Research Shows The Way!"

Only The New BS&B Phanto-Pumper Gives You Centralized Automatic . . .

- ✓ Wellhead Shut-In Control
- ✓ Well Test Control and Data Recording
- ✓ Well Flow Programming
- ✓ Tank Switching Control


ITEM 4 PRODUCTION SEPARATOR
TO GAS GATHERING SYSTEM
ITEM 5 MULTIPLE DETECTOR
ITEM 6 TEST METERING SEPARATOR
ITEM 9 LEASE SHUT-IN VALVE
ITEM 10 BACK PRESSURE VALVES
ITEM 7 INTEGRATING FLOW METER
TO TREATING SYSTEM OR TANK BATTERY
SAMPLE CONTAINERS IN HOUSING
ITEM 1 WELL TEST CONTROLLER
FROM WELL
ITEM 8 AUTOMATIC SAMPLER
WET OIL MANIFOLD (OPTIONAL)
ITEM 3 PRODUCTION & TEST MANIFOLD ASSEMBLY
TO TREATING SYSTEM OR TANK BATTERY
ITEM 2 STRIP CHART RECORDER

Typical BS&B PHANTO-PUMPER Well Test Installation (Electro-Pneumatic) and Typical Well Test Control Panel With Strip Chart Recorder



Typical Wellhead Shut-In Control Assembly

. . . Or Any Combination Of These In One Packaged System!

The BS&B PHANTO-PUMPER is that part of BS&B's new PHANTO-MATIC Lease System which automatically performs all lease operations between the wellhead and the gaging to the pipeline. It is the oil industry's first commercially available standard equipment for providing any combination of *centralized automatic* . . .

1. **Wellhead Shut-In Control** . . . Various types of wellhead shut-in control assemblies provide correct control for any combination of well flowing or pumping conditions.
2. **Well Test Control And Data Recording** . . . Wells are automatically switched from production to test and data is recorded on strip chart. Upon completion of test, well is automatically placed back into production and next well is put on test. Wells may be tested in any sequence, or for any time period.
3. **Well Flow Programming** . . . Production from wells is automatically programmed to meet state requirements. When allowable production has been reached, wells are automatically shut in.
4. **Tank Switching Control** . . . Tank battery control equipment automatically fills all tanks to capacity in a preset sequence, and automatically by-passes tanks already full or being run to pipeline, or to metering equipment.

The entire PHANTO-PUMPER System is designed "fail safe" so that in case of power failure or shut down, it will halt operations immediately until the trouble is remedied, and then will automatically start again at the same part of the sequence where it had ceased.

With the PHANTO-PUMPER System, the element of human error in lease operation is virtually eliminated by "set-and-forget" automatic controls which operate the system more accurately and economically than has ever heretofore been practical or possible.

The BS&B PHANTO-PUMPER and the BS&B PHANTO-GAGER together make up the complete BS&B PHANTO-MATIC Lease System which provides full lease automation from the wellhead to the pipeline. PHANTO-GAGER Systems automatically perform the following functions:

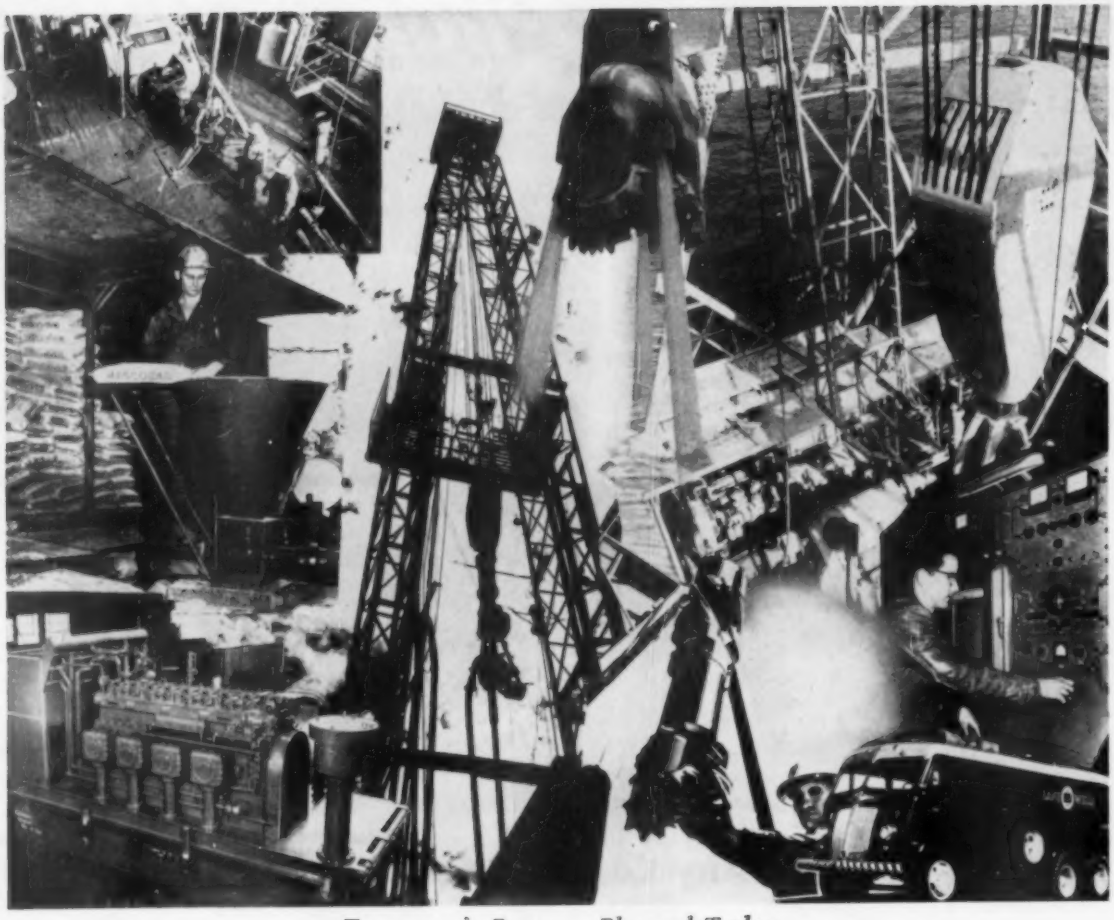
1. Measurement and recording of temperature compensated oil volume in barrels.
2. Measurement (or automatic sampling and subsequent determination) of quality and contaminant.
3. Running of crude from lease into connecting pipeline in accordance with predetermined schedules on an unattended basis.

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

Ask Your BS&B Man For Full Details, or write to . . .

BLACK, SIVALLS & BRYSON, INC.

Oilfield Equipment Division, Dept. 1-A9B
P. O. Box 1714 Oklahoma City, Oklahoma



Tomorrow's Progress Planned Today

TEXAS MID-CONTINENT OIL & GAS ASSOCIATION

38th
ANNUAL MEETING

Texas Hotel
Fort Worth, Texas
October 1-2, 1957

DRESSER salutes the members of the Texas Mid-Continent Oil & Gas Association for their many important contributions to the great progress of our vital oil and gas industries.

THE DRESSER INDUSTRIAL TEAM SERVES THE GROWING OIL,

the Dresser Badges of Merit plus+

CLARK

CLARK BROS. CO., Olean, New York—Gas turbines, engines, and reciprocating, centrifugal and axial flow compressors—gas, steam, electric and diesel driven.

DRESSER IDECO

DRESSER-IDECO COMPANY, Columbus, Ohio—Radio and television broadcasting towers, steel buildings, aircraft hangars, electric power substations.

DRESSER MANUFACTURING DIVISION

DRESSER MANUFACTURING DIVISION, Bradford, Pa.—Pipe line couplings, pipe repair sleeves and clamps, weldments, forgings, welding fittings, flanges, rings.

GUIBERSON

THE GUIBERSON CORPORATION, Dallas, Tex.—Swabs, packers, anchors, workover equipment—drilling heads, blowout preventers, tubing blocks, hooks, swivels, kellys, savers, unions. Gas lift equipment. Molded rubber products.

IDECO

IDECO, Dallas, Tex.—Hydrair* and Power Rigs; Full-View* Masts; substructures, single, dual and Drive-In Rambler Rigs; blocks, swivels, rotaries; mud pumps; petroleum equipment and supplies.

LANE WELLS

LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City, Okla.—Electric and Radioactivity Well Logging, Koneshot* perforating and bullet perforating, packers and bridging plugs.

Magcobar

MAGNET COVE BARIUM CORP., Houston, Tex.—Magcobar* and Magcogel* drilling muds and other specialized oil well drilling fluids and chemicals.

PACIFIC

PACIFIC PUMPS, INC., Huntington Park, Calif.—Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells.

ROOTS-CONNERSVILLE

ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.—Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, vacuum pumps, and positive displacement meters.

Security

SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif.—Rock bits, reamer rock bits and hole openers; reamers, casing scrapers and Neo-Red rubber stabilizers.

SIE

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO., Houston, Tex.—Seismograph systems and instruments—electronic, electro-mechanical. Computers—analog and digital; recording systems. Special transformers, reactors.

WELL SURVEYS

WELL SURVEYS, INC., Tulsa, Okla.—Nuclear and electronic research and development for the petroleum and other industries. Originators of radioactivity logging.

*Trademark registered

put this DRESSER *plus+* team to work for you!

You receive a bonus of extra value whenever you are served by any one of the Dresser companies. *Men with imagination* provide the research, engineering, manufacturing and service applications for the particular specialties of each Dresser operating unit. All Dresser companies work together with their combined experience and facilities to form the world-wide Dresser industrial team. This inter-company teamwork offers a bonus in greater experience and technical knowledge – backed by the extensive Dresser facilities – in the customer's specific industry. This intangible but important factor is known the world over as the Dresser plus+ . . . the mark of superior equipment and services for the oil, gas, chemical, electronic, and general industry.

Dresser's world-wide engineering experience in many industries plays a major role in the creation of new developments and improved technological methods. No other single company provides the same broad range of equipment and services. The Dresser plus+ is a symbol for the superior quality of equipment and technical services which have become the standard of comparison in industries the world over!

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EQUIPMENT AND TECHNICAL SERVICES

OIL • GAS
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GAS, CHEMICAL AND ELECTRONIC INDUSTRIES — *EVERYWHERE*

CP Cost-cutting Performance

28 YEARS OF SERVICE
TO THE PETROLEUM INDUSTRY

CP ROCK BITS...

THREE CONE BITS · REAMING BITS · REAMERS · DRILL COLLARS · TOOL JOINTS · SUBS · JUNK BASKETS

the best by far for footage

Chicago Pneumatic Fort Worth, Texas

Export Agent: Petroleum Machinery Corporation • 30 Rockefeller Plaza • New York 20, N. Y.

They Say—

Source of petrochem report

Dear Sir:

I read with great interest the synopsis in your September 2 issue ("Boom Glamor Fades Out," p. 94) on a report of the petrochemical industry that was written by a group of students at Harvard Business School. I feel your article was very interesting and certainly drew attention to the excellent piece of work these men produced.

The report was written by students, however, and not by "researchers." Therefore, it is not a Harvard Business School publication. It was my understanding that the students would make this clear to you and I believe on the first page of their report they stated in effect: "This report expresses only the conclusions and opinions of the authors and does not represent the views of the school, or of the business firms contacted or of the instructor in charge of the course."

It is obviously very important that this distinction be drawn.

The students' instructor is indeed proud of the report but regrets that you implied it was a product of the school's research department rather than that of a group of students. Should you refer to this article any further in your magazine it would be very much appreciated if this distinction would be drawn.

Robert L. Wiley, Jr.
Secretary to Professor Doriot
Harvard University
Graduate School of Business
Administration.

Can small companies survive?

"The free-enterprise system does not guarantee the right of survival to any company whether it be in the oil industry or any other industry. However, in the oil industry there is certainly a tremendous opportunity for any small company to prosper if it meets the test of service and efficiency . . .

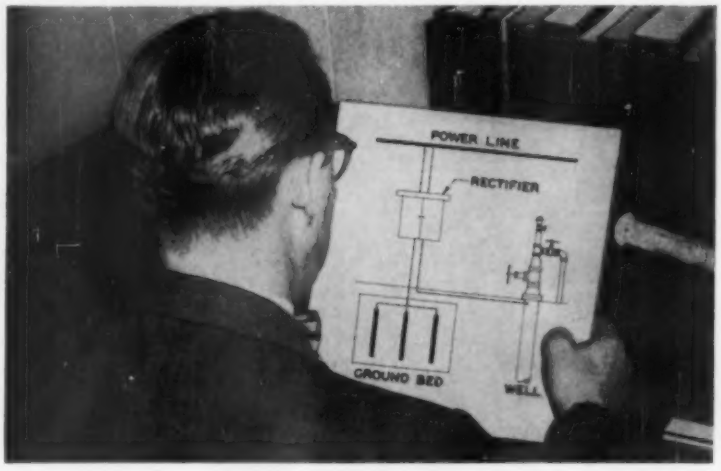
"Look at some of the independent marketing operations around the country. In some markets, these relatively small companies are leading the pack in pumping gasoline, and their competition includes the billion-dollar companies whose names are household words around the world. The same is, of course, true in other aspects of the petroleum business—among producers as well as refiners.

"Nor do I believe the era of expansion has passed us by . . . In pipelining, the distribution of petroleum products is undergoing significant changes. Common-carrier pipelines are being encouraged to provide distribution directly to air fields and to large population centers . . . In our own company, I take the point of view that our future will be limited only by our lack of courage and foresight. I think this equally applicable to other companies regardless of size in the petroleum industry today."

George S. Patterson, president, Buckeye Pipe Line Co., in a speech to the National Petroleum Association.

Atomic power at sea

"On one charge of uranium fuel, the nuclear-powered submarine Nautilus steamed 62,562 miles, over half of which were submerged. To duplicate this performance, a diesel-powered submarine the size of the Nautlius would have required over 2,000,000 gal. of



HOW A MAJOR OIL COMPANY USED RECTIFIERS TO STOP CORROSION OF WELL CASING

This major oil company has 33 of its wells in a pool in northwestern Kansas. Past experience indicated that external corrosion of casing would become a major maintenance item.

The wells were surveyed to determine the amount of induced current needed for cathodic protection. Then CSI was awarded a rectifier-installation contract on a competitive bid basis. Ground beds had to be individually designed for each well to meet the two-ohms circuit resistance specified.

CSI engineers furnished and installed 33 rectifiers, graphite anodes, coke breeze and all necessary connections. The job was finished ahead of the promised date, and to exact contract specifications. The cost was approximately $300 per well.

You'll find it pays to call CSI—for expert engineering, installation services and cathodic protection supplies. Estimates or quotations without obligation. Call or write today.

CSI
CORROSION SERVICES INCORPORATED
Tulsa, Oklahoma

P. O. Box 7343, Dept. J-18 Telephone: Circle 5-1351

WELL PROTECTION

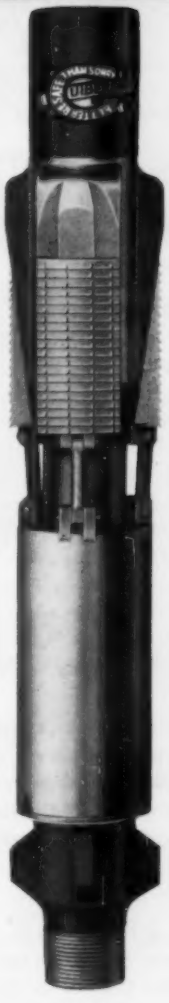
..and WELL WORTH IT!

GUIBERSON
TUBING CATCHERS

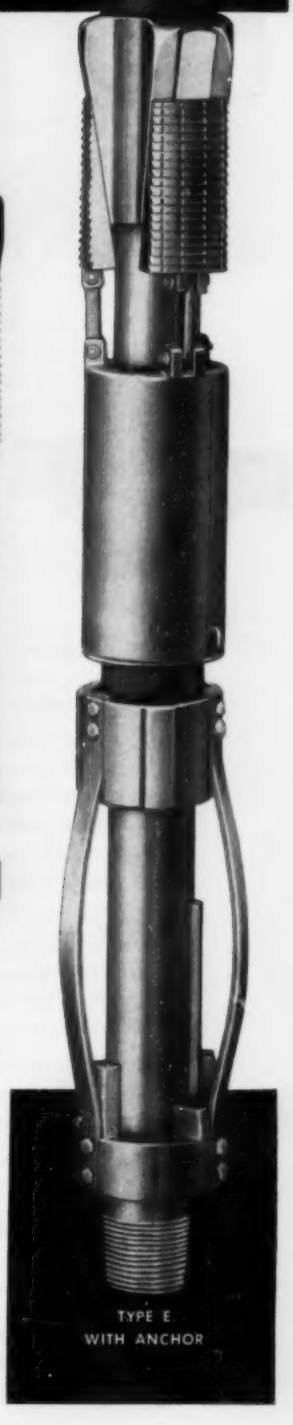
Guiberson tubing catcher with anchor stops tubing motion — gives you full protection running in and out the hole. This combination saves wear on tubing, collars and threads — helps prevent leaks. It makes the pumping operation produce more fluid with less power.

Guiberson tubing catcher gives you low-cost insurance against accidents, lost time and production. It lets you forget the danger of cork-screwed or telescoped tubing. Should the string part or fall, the Guiberson tubing catcher automatically stops tubing with a drop of less than three inches.

Guiberson tubing catchers are made in all casing sizes and weights.



TYPE E
TUBING CATCHER



TYPE E
WITH ANCHOR

THE
GUIBERSON
CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

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Thomas S. Gates, Jr., Secretary of the Navy, in a speech to the National Petroleum Association.

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Dr. John T. Rettaliata, president, Illinois Institute of Technology, in a speech before the Skokie Valley Industrial Association.

CALENDAR

OCTOBER

1-2 Texas Mid-Continent Oil and Gas Association, thirty-eighth annual meeting, Texas Hotel, Fort Worth.

1-4 National Association of Corrosion Engineers, north-central region, Sherman Hotel, Chicago.

1-4 National Association of Corrosion Engineers, south-central region, municipal auditorium, Oklahoma City.

2-4 Golden Trend Oil Show, Pauls Valley, Okla.

6-9 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, fall meeting, Adolphus, Baker, and Statler Hilton Hotels, Dallas.

7-9 National Electronics Conference, thirteenth annual meeting, Hotel Sherman, Chicago.

7-9 American Gas Association, annual convention, Kiel Auditorium, St. Louis.

7-11 American Institute of Electrical Engineers, fall general meeting, Morrison Hotel, Chicago.

10-11 California Natural Gasoline Association, thirty-second annual fall meeting, Huntington-Sheraton Hotel, Pasadena.

10-12 American Society of Mechanical Engineers, American Institute of Mining, Metallurgical & Petroleum Engineers, fuels conference, Chateau Frontenac, Quebec.

10-13 Louisiana Gulf Coast Oil Exposition, Lafayette, La.

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13-15 American Association of Oilwell Drilling Contractors, seventeenth annual meeting, Mayo Hotel, Tulsa.

13-19 OIL PROGRESS WEEK.

15-16 Gas Measurement Institute, sponsored by the University of Kansas, American Legion Hall, Liberal, Kans.

16-17 South Dakota Independent Oil Men's Association, convention, Alonzo Ward Hotel, Aberdeen, S. D.

17-18 Abilene, Tex., Geological Society; Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, Abilene chapter; West Central Texas Oil and Gas Association; and McMurry College, second annual petroleum conference on new developments and applications in log interpretation techniques, McMurry College, Abilene, Tex.

17-18 American Institute of Mining, Metallurgical, and Petroleum Engineers, Southern California petroleum section fall meeting, Biltmore Hotel, Los Angeles.

17-19 Four Corners Geological Society, second field conference, Gallup, N. M.

18 American Institute of Chemical Engineers, South Texas section, twelfth annual technical meeting, Moody Convention Center, Galveston, Tex.

20-22 National Association of Oil Equipment Jobbers, annual convention and trade show, Hotel Peabody, Memphis.

23-25 National Association of Corrosion Engineers, western region, seventh annual conference, U S. Grant Hotel, San Diego, Calif.

23-25 National Association of Corrosion Engineers, seventh biennial Permian basin corrosion tour, Lincoln Hotel, Odessa, Tex.

24-25 Rocky Mountain Oil and Gas Association, midyear meeting, Northern Hotel, Billings, Mont.

24-25 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.

25 Natural Gasoline Association of America, southern regional meeting, Washington-Youree and Captain Shreve Hotels, Shreveport.

25-26 West Texas Geological Society, fall field trip, Glass Mountains area, Holland Hotel, Alpine, Tex.

25-26 Abilene, Tex., Geological Society, Fort Worth Geological Society, joint field trip, San Saba County, Texas.

27-29 Independent Petroleum Association of America, annual membership meeting, Statler Hilton Hotel, Dallas.

28-30 National Lubricating Grease Institute, twenty-fifth annual meeting, Edgewater Beach Hotel, Chicago.

31-Nov. 1 American Association of Petroleum Geologists, Mid-Continent regional meeting, Education Building, Fairgrounds, Tulsa.

NOVEMBER

3-8 Society for Nondestructive Testing, second international conference, Hotel Morrison, Chicago.

6-8 Gulf Coast Association of Geological Societies, seventh annual convention, Roosevelt Hotel, New Orleans.

6-8 Society of Automotive Engineers, national fuels and lubricants meeting, Hotel Statler, Cleveland.

11-14 Society of Exploration Geophysicists, twenty-seventh annual meeting, Statler-Hilton Hotel, Dallas.

11-14 American Petroleum Institute, thirty-seventh annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.

12-14 National Association of Corrosion Engineers, northwest region fall meeting, Penn-Sheraton Hotel, Pittsburgh.

22 Natural Gasoline Association of America, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Tex.

DECEMBER

1-3 Interstate Oil Compact Commission, annual meeting, Tulsa.

1-6 American Society of Mechanical Engineers, annual meeting, Statler Hotel, New York.

2-6 Twenty-sixth Exposition of Chemical Industries, Coliseum, New York.

8-11 American Institute of Chemical Engineers, annual meeting, Conrad Hilton Hotel, Chicago.

JANUARY

16-18 Association of Oilwell Servicing Contractors, second annual convention, Baker Hotel, Dallas.

19-22 Pipe Line Contractors Association, tenth annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

31 Natural Gasoline Association of America, regional meeting, Skirvin Hotel, Oklahoma City.

FEBRUARY

16-20 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, Hotel Statler, New York.

26-28 American Petroleum Institute, Division of Production, southern district meeting, Shamrock-Hilton Hotel, Houston.

28 Natural Gasoline Association of America, Permian basin regional meeting, Lincoln Hotel, Odessa, Tex.

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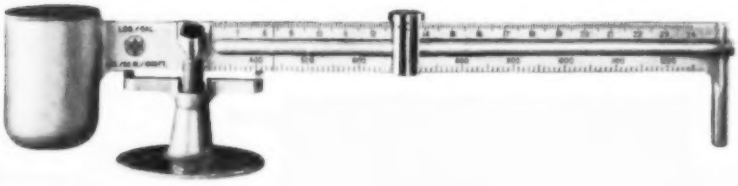

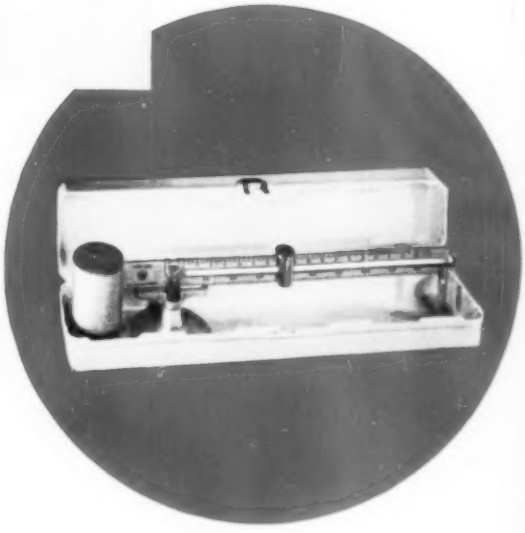

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TULSA, OKLAHOMA

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JOURNALLY SPEAKING

Some Press Brickbats

INTERESTING comments have floated into the Journal office from readers since we ran a short primer advising oil men how to meet the press (OGJ, Sept. 16, p. 104).

One delightful note came from J. Anthony Marcus of New York. He is a Russian-born oil trader, businessman, writer, and lecturer, who has become recognized as an authority on Russia. Marcus only a few months ago wrote a timely article saying that Russia aims to nudge American oil interests out of the Middle East as part of its long-range drive to cripple U.S. industry.

Said Marcus of reporters: "I have been interviewed here and abroad so many times, have been mutilated by photographers on so many occasions that I just pay no attention to reporters. When I am called upon to give a story I do the best I can in my own, natural way and call it a day."

Of course, what Marcus says may explain why he has been interviewed so widely. He just says what comes naturally.

Another letter from an oil-company public relations man who must remain anonymous advised reporters to be patient.

"Oil public relations men, who once were reporters too, are trying hard to educate oil people just along the lines you mentioned," he said.

The P.R. man then added: "Let us hope that in time when the 'call' is extended by the press, all oil men will walk to the altar with hands upraised and make their 'Decision for Publicity.'"

Most acid comment came from a "friend" concerning the advice to oil men occasionally to break bread with the press. He asked: "What gives with you freeloaders. Business bad?"

But that's tame. We once heard a critic say, "You reporters will even try to get a press pass to Heaven."

A Pipe (line) Dream

A STRANGER dropped by Journal offices in Tulsa recently and tried to interest our engineering editors in a mammoth pipeline project.

The man envisioned a tremendous fresh-water pipeline from the Great Lakes to the gulf. It would bring water to arid regions of the Southwest. A four-lane highway would be built on top of it. Its innards would be so big submarines could sail up and down.

The engineers didn't throw the guy out at once. They listened patiently to his story first.

They believe that many fantastic claims about future pipelining may come true. They have to look at all of them, because the oil industry has shown the world what can be done with the pipelining technique.

There's some indication they may be right too.

Imagine grinding up coal, wetting it into a slurry, and then pumping it over 100 miles through a pipeline from the mine to a plant which uses it.

Swiss dairy farmers are using plastic pipelines to send their milk from Alpine villages to cheese factories in the valley.

Some pipeliners think the day will come in the U.S. when nearly every town of any size will have a products pipeline bringing petroleum products to its terminal from a main products artery or a refining center.

Even more fantastic is the idea that some day we may shoot freight across the country at terrific speeds through pneumatic tubes.

So you see why the engineers couldn't throw out the guy who had an idea for a simple fresh-water pipeline.

Makings of a Blowout

TRUTHFULLY now, haven't you often wished on a summer eve after a hard day that you didn't have to mow the grass? Haven't you said: Wish I could blow the whole blamed yard up?

Well brother, you have the makings in the garage—that sack of ammonium nitrate fertilizer.

Our petrochemical friends tell us nitrate fertilizer is a Dr. Jekyll and Mr. Hyde. It remains fertilizer until you do three things: Mix it with the correct amount of fuel oil, confine it, and detonate it with a charge of dynamite.

Monsanto Chemical reports that ammonium nitrate fertilizer has become a common blasting powder with many heavy construction contractors, with quarry men and strip coal mine operators. They say it's safe, can be controlled easily, and is far cheaper than conventional blasting agents.

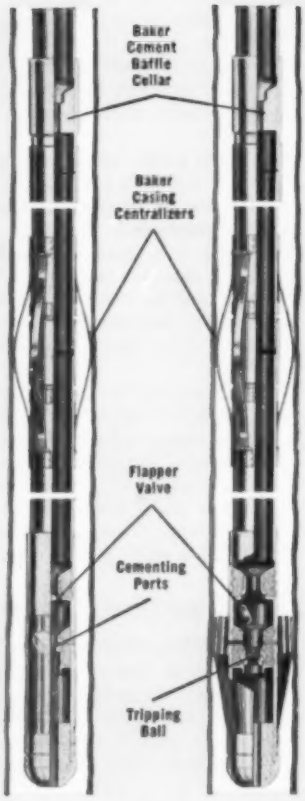
After all, it was a shipload of ammonium nitrate fertilizer that nearly blew the Texas City refining area off the map 10 years ago.

—Bill Bachman.

Protect permeable low pressure zones with the BAKER TRIPLEX cementing shoe...

Baker TRIPLEX Cementing Shoe – Product No. 1363

The overlapping Petals form a strong, tight bridge to prevent downward movement of slurry.



Cementing casing at a predetermined point above bottom, and at the same time protecting a lower, permeable zone from cement contamination always has been a difficult problem. Such work is now a routine operation with a Baker TRIPLEX Cementing Shoe.

A special float shoe is combined with a Baker Metal Petal Basket that expands to form a bridge and retain cement slurry **above** the Basket, even in large-diameter or irregularly shaped holes. The TRIPLEX Shoe, with its flapper-type back-pressure valve, operates as a conventional **float** shoe while landing the casing and conditioning the hole. When cementing is done and pump pressure is stopped, the valve closes and cement is **held in place behind the casing until it sets.**

Baker Casing Centralizers are installed on (and above) the shoe joint, thus providing a uniform annulus to receive the slurry. While running-in, a Hold-Down Strap (secured by shear screws) retains the Basket against the TRIPLEX Shoe, and the cementing ports are covered by the Tripping Valve. After reaching the desired point, a Tripping Ball is dropped to seat upon the Tripping Valve. Pressure is applied to shear the screws, force the Tripping Valve downward, and expose the cementing ports. This action releases the Hold-Down Strap and the Basket expands against the walls of the hole. When cementing starts, the slurry is directed upward by Baker "Whirling" Action, and retained **above** the shoe by the Metal Petal Basket.

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What about the final quarter?

ON Tuesday the oil industry starts on its final quarter. This year, as in many years of the past, what happens in balancing supply and demand is of urgent concern.

Operators in all divisions of the industry have house cleaning to do. Not only must they improve current statistical conditions, but just as important, they must get their collective house in order for a new year.

The immediate need is a realistic acceptance of what is required in domestic crude runs to stills as a basis for supplying current demands. At the same time, it is mandatory to correct unhealthy inventory situations.

Runs to stills were up again in early September. They were ahead of the same period of last year and an analysis of stocks and future demands shows they were not needed.

Stocks of four major refining products on September 20 were 431,533,000 bbl., a gain of 24,281,000 bbl. over the comparable date last year, and they were too high at that time. Gasoline stocks have been brought down to about last year's. But it is too early to start large accumulation of this product for next year.

Among the three remaining major products, kerosine and distillate stocks are up 10.4 per cent and residual fuel 12 per cent.

In a healthy market situation it would be normal to add to the inventories of these products during October. But increases are not needed this month. Crude runs should be lowered over the next 30 days at least.

In this connection there are refiners who at this season profess to be concerned that they will not have enough distillates over the next 6 months, particularly if temperatures are below normal.

But too often refiners as a unit have expanded crude runs to stills to take care of what are partially byproduct winter markets. Come May 1 they have excessive stocks of their principal money product—gasoline.

Refining has two ways to take care of unexpected demands. Over-all, operators have excess plant capacity. Furthermore, modern processing provides for changes in yields and output which also aid in taking care of emergencies.

Apropos of what the industry's operating positions should be January 1 all economists are urging caution as to 1958 needs. Some are even predicting that total demand will be less than this year. This reflects the fact that we will not have the large export demand brought about by the Suez crisis. Furthermore, general economic conditions will have a bearing on domestic consumption.

So the first move in doing what must be done over the next 92 days is up to refiners. They are the first line in establishing a sound operating level. This done, the further duty in balancing supplies and demand passes to the producers of crude oil. This includes the still-unresolved problem of imports.

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This Harbor Department office will be 18 ft. lower by 1977 if nothing is done.

It's Flood or Sink, Long Beach Told

LONG BEACH. — Massive water flooding and quick unitization are imperative if subsidence is to halt in Long Beach's Wilmington field.

Three independent reports, based on thorough studies in the field, warn that water injection on a unitized basis is the only solution to the problem of sinking surface in the Long Beach Harbor area.

The warning comes at a time when pressure for action is mounting from city officials, the U. S. Navy, the state legislature, and the populace.

The three reports spell out how much the injection project will cost, how big it must be, and what will happen if nothing is done.

Summed up, the reports say these are the alternatives:

. . . **If Long Beach** wants to maintain pressures in the field at present levels, a 780,000-bbl.-daily flood costing $25 million is mandatory.

. . . **If the city** wants to increase field pressures to their original levels within 3 years, a 1,000,000-bbl.-daily flood will be necessary, and the cost will be $32 million.

. . . **If nothing is done,** the ultimate depth at the center of the subsidence bowl will hit 43 ft. by 1977.

These prospects and recommendations were outlined in reports submitted by Core Laboratories, Inc., DeGolyer & MacNaughton, Dallas, and Dr. Frank S. Hudson, Los Angeles consulting geologist.

The reports were ordered prepared by Long Beach in advance of a meeting of a State Assembly Interim Committee on subsidence legislation. The meeting will be held October 3-4 in Long Beach.

Formation problems . . . Core Lab said floods are the only answer because of subsurface conditions.

The floods must be big because of evidence of communication between the seven major zones and six major faults in the field. This precludes any single zone or fault-block flood.

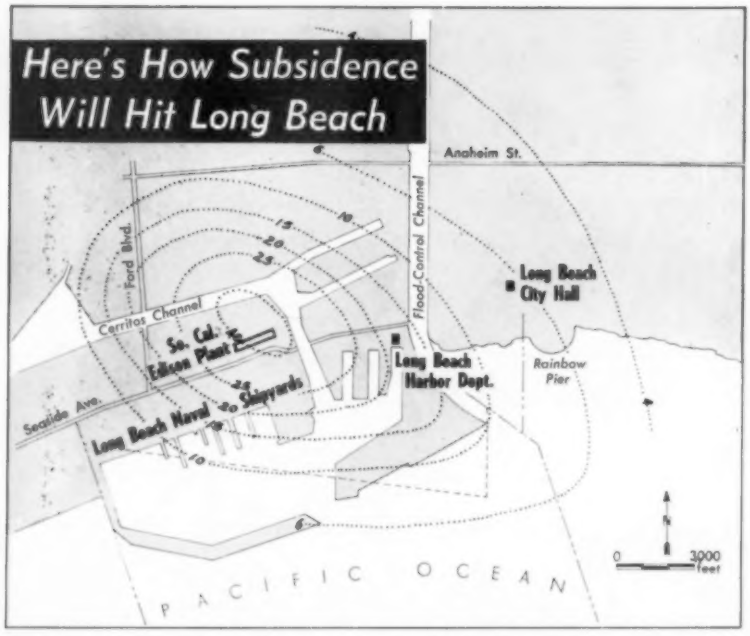
Core Lab said unitization is necessary to start such a flood. In fact, all three reports state that unitization is the major issue in the battle against subsidence.

The city of Long Beach already has voted to seek voluntary unitization first. If that fails, two alternate plans have been proposed:

. . . **A law** creating a subsidence abatement district in the area and compulsory unitization.

. . . **A law** authorizing the state oil and gas supervisor to install a compulsory unitization plan if voluntary unitization won't succeed.

Problem of numbers . . . Unitizing Wilmington field is complicated by



HERE'S the predicted shape and contour of sunken bowl at Long Beach in 1977, provided nothing is done to halt subsidence. Figures on contour lines show depth of bowl.

the fact that there are 118 operators.

Four companies, however, control 85 per cent of the production. They are Long Beach Oil Development Co., Richfield Oil Corp., Union Pacific Railroad Co., and General Petroleum Corp.

These four companies and Phillips Petroleum Co., which has substantial holdings in the southeast portion of the field, are working toward unitizing their properties with those of the city. But even if this step were taken, zone intercommunication would prevent large-scale water repressuring.

Navy warning . . . Evidence that time is running out for the city on at least one important front cropped up again recently.

Rear Admiral R. K. James, commandant of the $170 million Long Beach Naval Shipyard, warned that, unless the city adopts some concrete antisubsidence program soon, there is evidence Congress won't appropriate any more money for remedial subsidence work at the base.

The admiral set April 1958 as the deadline for city action as far as the Navy is concerned.

The big repair base is vital to Long Beach's economy, and the threat of a shutdown is spurring efforts to solve the subsidence problem.

In addition to the Navy base, subsidence is raising havoc with private property. Southern California Edison Co. has a big steam-generating plant virtually in the center of the subsidence bowl (see map).

Oil companies have multimillion-dollar investments in production equipment and other facilities which are affected.

Sinking in the immediate Long Beach Harbor area has cost the city itself millions in repair bills to keep its docks in working order and in building dikes to keep the Pacific Ocean from spilling into populated areas now well below sea level.

Flood program . . . The key conclusion reached in the Core Lab report is that a flood can be designed and operated in Wilmington field to restore pressures and increase oil production. The report hedges on any outright declaration that such a flood would stop subsidence completely.

"It can only be said at this point that subsidence due to withdrawals from the reservoir would be reduced by injection," it said.

What's been done . . . Core Lab says several pilot floods already have indicated that a full-scale flood would increase crude production.

Typical of these pilot floods is Union Pacific's in the Tar zone of Fault Block III in the central part of the field. The railroad has been injecting water since 1954.

Cumulative injection to date is 5,570,000 bbl. of water, and the test has produced 1,470,000 bbl. of crude since it began.

Core Lab cites one well as typical of results obtained in the five-spot flood. The well's production went from a preflood level of 39 bbl. daily to 149 bbl. daily. Also a steady pressure decline in the zone halted.

The DeGolyer & MacNaughton report seconds Core Lab's statement that there is evidence of communication from zone to zone in the field.

The report, which is concerned with production and pressure history of the field, says the communication results from a small vertical displacement at lower structure positions. This makes possible a lateral fluid movement and pressure communication in downstructure parts of the field.

Subsidence story . . . In a separate report—but tied in with the other two—Dr. Hudson declares that all evidence points to oil withdrawals as the major cause of subsidence.

Each year of operation, he says, adds evidence to support this conclusion. Here is some of the evidence:

. . . Shape of the subsiding area resembles that of the oil field (see map).

. . . There is coincidence of position in the bottom of the bowl and the crest of the Wilmington dome, where amounts of fluid withdrawal and pressure decline are greatest.

. . . There is mechanical evidence in proof of compaction of the oil zones.

. . . The subsidence rate increases as the rate of oil production increases.

. . . There is a consistent mathematical relationship between subsidence and cumulative oil production.

Dr. Hudson says all other suggested causes of subsidence are either inadequate or theoretically unsound. And he agrees with the two other reports that water injection offers the only hope for halting the sinking surface.

The Hudson report predicts ultimate subsidence, unless something is done soon, may be about 43 ft. at the center of the bowl. This estimate is based on the premise that all of the oil zones will compact.

If this occurs, the bowl-shaped area in 1977 will grow larger and downtown Long Beach will sink 4 to 6 ft.

If only the upper oil zones compact, ultimate depth of the bottom of the bowl will be 38 ft. in the year 1973. This would be a 10-ft. drop from the present level.

Another headache . . . Further development of Wilmington field to the southeast is posing an additional problem. The field is believed to extend 3 miles beyond present production limits.

Hudson believes that development of this 3,800-acre area will not deepen the subsidence bowl beyond the 38-ft. or 43-ft. maximum, but he fears it will add considerably to subsidence of downtown Long Beach.

High-Octane Troubles To Stay

NEW YORK. — Higher operating severities and further plant investments are in the book for refiners.

This is true in spite of the expected slow down in upward trend of motor fuel octanes to half the current rate. Refiners will still need to maintain their pace on operations because it's increasingly difficult to boost each successive octane number.

These views were expressed last week by Paul F. Swanson, director of process engineering for the M. W. Kellogg Co. He addressed the American Institute of Chemical Engineers.

Swanson sees gasoline consumption leveling off at the present 43 per cent of total product demand in this country. As compression ratios approach the 12:1 level, he believes that the pace will ease. This should make the average annual gain in octane numbers back off to a little more than half the current 1.2-number rate.

It would be wrong to conclude, however, that all of the technological discoveries have been made along this line, or that most investments in refining capacity have been spent.

Swanson looks to continued expansion of world capacity on the order of some 10 million barrels per day over the next 10 years. This will cost roughly $10 billion and most of the expansion will take place abroad.

Swanson's 1967 predictions on motor-fuel octanes call for a weighted average of 104 for premium grade against the present 98, in the United States. Regular grade, he believes, will run 97 by then. This output on a 40 to 60 per cent breakdown on premium and regular grade would require 100-octane pool gasoline production.

To get this, he sees roughly 500,000 more barrels per day capacity in alkylation.

If the 104-octane prediction proves conservative and superpremium fuels of 106 and 110 octane come into the picture in the next 10 years, additional investments will be necessary in superfractionation, extraction, and recycle facilities.

Extraction and recycling of catalytic reformate becomes justified after severity of once-through reforming reaches the 97 to 98 clear octane level, according to Kellogg studies. Cat reforming will continue to supply the necessary hydrogen for most desulfurization requirements. Swanson predicted that 1 million barrels per day of capacity will be installed to desulfurize middle distillates by catalytic means.

Pointing to progress in automation, Swanson sees improvement coming. But he discounts the possibility of operating refineries by push-button installed in company headquarters.

Fish Buys Offshore Equipment

HOUSTON.—Continental Marine Exploration Co. has acquired all drilling equipment of Morris & Hamilton, Inc., Houston-based offshore drilling contractor.

Continental Marine is a wholly owned subsidiary of Fish Northwest Constructors, Inc., which is one of the Fish group of companies—internationally known gas transmission system engineers and contractors.

Fish Northwest recently completed the 1,500-mile Pacific Northwest gas line and is involved in plans for new crude and gas lines in Argentina.

This will be the Fish group's first move in offshore operations. Continental Marine equipment will initially include one offshore mobile drilling platform, one bay drilling barge, and three land rigs.

C. R. Williams, president of Continental Marine, said plans call for the construction of a second bay barge capable of drilling in deep inland waters. The company will also develop new offshore equipment. Williams indicated that engineering and design experience of the Fish companies will be at the company's disposal.

The firm's only offshore platform is the Mobile M&H No. 12, built in 1956. It's a submersible-hull type of vessel for open-sea operations in medium-depth waters. The platform has successfully survived four coastal storms while drilling in the Gulf of Mexico.

The barge is now drilling under contract for The Texas Co. off Timbalier Island, La.

Officers of Continental Marine include R. E. Jones, vice president, and Robert K. Tyson, secretary-treasurer. Jones is associated with the Fish companies, and Tyson was formerly with Morris & Hamilton.

All operating personnel with Morris & Hamilton will be retained by Continental Marine. Joe C. Lewis, offshore superintendent, and Joe E. Steward, land superintendent, will continue in the same capacities under the direction of G. D. Morris and H. E. Hamilton, who guided the drilling firm for many years.

New Plants Coming

U.S., Canadian marketers plan East Coast refineries

TWO NEW REFINERIES along the East Coast of the United States and Canada are in the planning stages.

Hess Transport & Trading, Inc., major fuel marketers in the New York area, have received a permit to build a refinery at Port Reading, N. J. The permit issued by Woodbridge Township covers a 100-acre tract of land located on deep water at Arthur Kill, north of Perth Amboy.

Hess is now nearing completion of plans for the plant. Officials declined to reveal its capacity, cost, or processes planned until design work is completed.

If the plant is built, it will be the second independent refinery to go up on the East Coast. Commerce Oil Refining Corp. recently let contract to Fluor Corp., Ltd., for a 43,000-bbl. refinery at Jamestown, R. I.

Meanwhile, Canadian refining circles are buzzing with reports that industrialist K. C. Irving plans a new refinery at St. John, New Brunswick. Irving Oil Co. is an old marketing company in the Maritime Provinces. However, reports that Irving is being joined in the venture by Standard Oil Co. (N. J.), Socony Mobil Oil Co., and California Texas Oil Co. have been denied by those majors.

Texas Underage Increases

AUSTIN.—Texas oil wells produced 12.86 per cent under their allowables during the first half of this year.

Production totaled 561,535,458 bbl., and underage amounted to 85,885,506 bbl. or about 475,000 bbl. daily. The Texas Railroad Commission classifies underproduction as allocated oil which a producer is unable to sell.

Underage during the past few months has been greater than the average for the 6-month period because of increased pipeline proration. In June, underage averaged 13.43 per cent, and is expected to go higher.

Two of the commission districts averaged more than 25 per cent underproduction for the 6-month period—North Texas with 27.77 per cent and Panhandle with 27.11 per cent. Best performance was in District 6, including East Texas, which scored only 4 per cent underage.

Retractable Bit Unveiled

Carter says it'll cut penetration costs 25 per cent. It works like this: Collapsed bit goes down on wire line, engages drill collar, then is turned by drill casing

TULSA. — Research engineers for Carter Oil Co. last week took the wraps off their development work with wire line retractable rock bits. They reported tests of the drilling technique showed that savings up to 25 per cent of conventional drilling costs are possible.

The special bits are not available to the industry yet. Carter has left further development to manufacturers. Hughes Tool Co. has a nonexclusive license for their manufacture and sale. Others reportedly are investigating them. Carter engineers said it was felt that final development could be done more efficiently by an organization equipped for specialized machining and metallurgy work.

Reports have been current in the industry for more than a year that Carter was engaged in work on a retractable bit. Until last week results of field tests had been secret.

They were revealed in a paper by R. H. Blood given here before the twelfth annual petroleum mechanical engineering conference sponsored by A.S.M.E. Authors with Blood were J. M. Camp and J. E. Ortloff. All are Carter research engineers.

The savings . . . The technique of drilling with casing and collapsible drag bits is not new, Carter researchers told the mechanical engineers.

Before muds were developed to control heaving shales, this method was used in penetrating these shales in the Gulf Coast and East Texas. The shale sections could be penetrated without pulling pipe to change bits. The casing was carried to total depth and cemented in place.

Carter research team further developed the idea and then tested it in field drilling to compare costs with standard rotary drilling in 7,500-ft. Mid-Continent wells.

The 25 per cent savings indicated by the tests were based on:

. . . Less time. Round trips are not necessary to change bits. This is done by drawing up the collapsible bit by wire line.

. . . Less labor. One less man on a drilling crew is needed.

. . . Less investment in equipment. There is no need for a big derrick or high-powered, high-speed draw works for hoisting drill pipe. Only hoisting equipment needed are a short mast and hydraulic jack or similar tool for emergency pulling operations at slow speed or for adding simple stands of drill casing. Rotation and circulation are conventional except that a special casing drive replaced the standard rotary kelly and bushing.

How it works . . . In conducting its Oklahoma field tests, Carter had the help of Austin Drilling Co., Seminole.

A 7-in. o.d. streamlined casing was selected for the drill string.

Two retractable rock-bit designs were considered: A four-cone and a three-cone.

The bits passed in a collapsed position through the casing bore and then expanded to cut a hole large enough for the casing to pass. The bits were moved in and out of the hole by a swabbing line.

Four-cone bit . . . The four-cone bit is designed to carry the collapsed cutters in pairs for making round trips.

A special drill collar receives the bit. Then when the spring dogs contact a shoulder near the bottom of the drill collar, they stop downward movement of the two center cutters.

A sinker bar at the top of the bit pushes the two hinged outer cutters against a wedge supported by the dogs. This wedge in turn forces the outer cutters to gage diameter. At the same time a heavy spring is compressed and the upper latching dogs are carried past a downward-facing shoulder near the upper end of the bit assembly. The seal is expanded to fit the bore of the drill collar.

The overshot attached to the cable is released from the bit spearhead when a tripping sleeve is dropped down the cable from the surface. The cable is then reeled from the well.

The casing then is lowered until the bit reaches bottom. A drive lug extending downward from the upper shoulder transmits drilling torque

through one of the upper dogs to rotate the bit.

Mud coming down the casing bore is diverted by the seal through ports and down the center of the bit body. The stream is divided into two jets which strike the bottom of the well between the outer and inner cones.

Worn out bits are replaced by reversing the process.

The four-cone bit was tested five times in the field and drilled 1,142 ft. of hole. Drilling weights and rotating speeds were about the same as those of conventional drilling. However, its drilling rate was only 65 per cent of the conventional method and average footage was only 55 per cent.

Three-cone bit . . . This version proved more successful and competitive with rotary rock bits.

Life of the three-cone bit was 90 per cent of conventional bit life. Drilling rates were equal. This means that the savings over conventional drilling could be realized through lighter equipment, less labor, and by time saved by fewer round trips.

The three cones are arranged in single file when the bit is collapsed and received inside the special drill collar. Each cone is stopped successively by contacting separate spring-loaded dogs in the locking recess of the collar. Thus all three cones are positioned at the lower end of the drill collar. A heavy central mandrel to which the cone carriers are attached continues downward. It wedges the cone legs outward against the lower end of the drill-collar bore.

Corrugations in the casing bore engage the outside of the same legs to transmit torque directly from the drill collar to the bit. An expanding packer is held down by two latching dogs near the upper end of the bit assembly. The packer diverts drilling mud through the bore of the mandrel and out through a nozzle at the lower end. The fluid jets the bottom of the hole slightly off center.

The Carter researchers estimated savings of 25 per cent of penetration costs could be made in 7,500-ft. drilling with the three-cone retractable bit.

Savings expected also should increase with depth. But they added one piece of advice: In wells shallower than about 4,500 ft. streamlined drill casing must be replaced by cheaper A.P.I. casing to save money.

A.S.M.E. Also Heard . . .

BESIDES Carter's new retractable bit, papers were presented on scores of mechanical problems.

More than 650 registrants at the annual petroleum conference of the American Society of Mechanical Engineers were briefed on developments and trends in drilling, production, refining, and pipelining.

Here, in brief, are some highlights of the meeting.

Drilling . . . Speakers at the conference indicated the oil industry can expect these drilling developments:

. . . Air and gas drilling. Future of this technique is assured. Savings in time and money are almost unbelievable. But the method will only become widespread when successful solutions are found to locating water and sealing off water zones.

Results of air-gas drilling when compared with mud are so promising that they serve as a great incentive to overcome the problems. Phillips Petroleum Co. field tests in Texas showed this: Over 1,000 rotating hours and 120 bits were saved per well by drilling with air in preference to mud. This does not include the time saved on trips.

Penetration rates up to 90 ft. an hour were achieved with air in the Phillips' tests. This compares with rates of 3-5 ft. per hour subsequently obtained with mud in same area and formation. Bit footages varied from 1,000 to 1,500 ft. per bit for air as compared to 40,100 ft. for mud.

. . . Aerated mud drilling. Its future as a way of increasing penetration rate and bit life depends on two developments: Solving problem of sloughing shale and increasing the cutting-carrying capacity of the mixture.

. . . Handling 15,000 psi. Wellhead assemblies, high-strength tubing, and completion techniques have been developed that promise to handle extremely high pressures encountered in deep drilling.

This has been made possible by three important developments in wellhead manufacture:

. . . Standard for flanges for 15,000 psi. working pressure service which will make all production equipment interchangeable.

. . . Proven method for designing special closures such as valve bonnets, blowout preventer bonnets for high-pressure service.

. . . Ring gasket design method which will materially improve the sealing ability of present A.P.I. flanges.

Pipelining . . . Engineers involved in pipeline problems heard these predictions:

. . . Solid transmission. The gilsonite pipeline in the Rockies may be the start of a trend. A great potential exists for this means of transport, particularly where large tonnages are to be handled and where other transportation is impractical or too costly.

. . . Plastic pipe. Materials presently being used for extruded plastic pipe will hold their place in the market.

Low-pressure polyethylenes likely will find increasing use in the oil country when better joining methods and fittings are developed. New thermoplastics are not likely to achieve volume production in the near future because of current high costs. Reinforced plastic pipe will start competing with steel in relatively high-pressure applications.

Refining . . . A report on the future of gas turbines highlighted sessions of the conference dealing with process equipment.

"There are definite areas in refinery operations where use of gas turbines is a definite economic advantage," C. R. Apitz of Clark Brothers Co., Houston, said.

"More and more of these areas will be defined in the next few years as use of gas turbines increases . . . The future of gas-turbine application is dependent upon imaginative application of its dual function as a producer of shaft power and economically recoverable exhaust heat."

Production . . . Automation held the spotlight in this division of the industry.

Two authors noted these trends:

. . . Water-flood projects. Use of automatic instruments such as meters, pressure gages, control valves, temperature controllers, and indicators will increase in water-flood projects. They reduce costs and make flood more dependable, safer and more efficient.

. . . Safety factor. In considering lease automation from wellhead to pipeline these considerations are uppermost: All controls and valves must have fail-safe features so that in event of failure the lease will be shut in. All control valves must have tight shutoff. All electrical controls must be simple in operation. All metering equipment for well testing must have good repeatability. In short, custody transfer systems must be foolproof.

The Oil Industry Still Needs More Engineers

Oil companies throughout the country were asked to analyze the shortage of engineers. Here are their composite replies:

Q. Do you think there's still a shortage of experienced engineers?

A. Yes. The market is a bit softer in some branches. But petroleum, mechanical, and chemical engineers are still short.

Q. Is it easier to find good young beginning engineers?

A. No. Real good youngsters are always hard to find. This is especially true for beginners capable of research.

Q. What are your expected needs in the next 5 years?

A. Demand for engineers will grow as oil industry expands and becomes more technical.

Q. What branch of engineering do you expect to need most?

A. The oil industry will need graduates from nearly all engineering sciences but particularly petroleum, electrical, mechanical, and chemical.

Q. Has starting pay for beginning engineers risen in the last year?

A. Yes, from $25 to $50 per month, making starting pay range from $425 to $525 per month depending on type of degree.

Q. Has pay for experienced engineers advanced too?

A. Yes. In the last year advances averaged from 6 to 17 per cent plus merit increases.

How the Future Looks for Engineers

ENGINEERING SENIORS in the Class of '58 are enrolling this month at colleges over the country for their last year.

One question uppermost in the minds of all: What will job prospects be when June graduation comes?

They'll be excellent in the oil industry. For instance:

. . . **Plenty of jobs** will be available in nearly all branches.

. . . **Pay likely will be higher** than ever.

. . . **Policies are changing** within companies to take better advantage of engineering talent as the expanding economy continues to place a premium on technical training.

A survey of oil companies in every part of the country made by The Oil and Gas Journal revealed the shortage of engineers still persists in the petroleum industry. The shortage may not be as acute as in former years, but so far the surplus of engineers showing up in the defense industry has not made its appearance in oil.

A large majority of oil companies reported they will have heavy demand in 1958 for all types of scientifically trained men. They believe the shortage of engineers still exists. A minority—larger than in the past—reported their demands will be less in 1958. They believe the shortage is easing up.

Those companies whose engineering needs have dropped, however, admit their situation may differ from the industry pattern. They attribute their decreased need for engineering talent to an oil industry development which has seen domestic production and drilling activity fall sharply. Any step-up in activity would see them back into the manpower market.

Illustrating the point, the chief engineer for a major operating in Texas said his division was staffed on the basis of 40 rigs running for the company. At present only 14 are running. The result is a sharp drop in need for petroleum engineering work. Still he said his company was looking for a few talented young engineers, anticipating future needs.

Premium for brains . . . Every oil company, the Journal survey showed, is hunting for the bright young engineer.

Several oil company personnel chiefs stated they would hire a graduate in the upper quarter of his class no matter in what branch of engineering he was trained.

One commented the engineering job situation may be difficult this year in one respect. Graduates in the upper fourth of their classes can pick and choose from many offers. Those in the lower fourth may have to scramble a little more than in the past.

This situation was emphasized by

one large company operating in the Southwest. Its industrial-relations chief reported his recruiters planned to pass up making the rounds of colleges this year because slackened operations have temporarily reduced their need for new engineers.

He added, however: "We won't pass up hiring a good looking beginner engineer even though we don't need him now. We know we'll need him later."

Another technical man still riding high is the fellow with an advanced degree capable of doing research. He's in the enviable position of being able almost to write his own ticket.

Experience of another oil company personnel chief points up this tight situation. "The research man is scarce as hen's teeth," he commented. "You have a tough time finding him and just as tough a time hiring him after you do find one."

He cited the example of a geologist who recently obtained his doctorate and had performed some well regarded research work in this field while taking his degree. This personnel man offered him $750 a month and wound up making the lowest offer of the many the geologist got. The young man started work with another company at $1,000 a month.

Several others recited shortages of the research-type graduate. One company said a few months ago it desperately needed a research man to do a special "mud study" on clays. Officials nearly despaired before they finally found a man for the work.

Another company with an ambitious and successful research and development program said it had several projects lying in "cold storage" just waiting for the right man to head up a research team to tackle them.

So it went. The pastures are green for those with research ability.

Who's ahead? . . . Which engineering specialty currently is in greatest demand?

Apparently the three most needed in the oil industry are mechanical, chemical, and petroleum or production engineers. Need for men in these categories was most often mentioned by oil companies contacted by Journal editors. But the demand will also be firm for civil and electrical (power) engineers in the oil industry.

The prominent need for mechanical engineers in oil may come as a surprise to some. But it reflects the tremendous investment the industry has in prime movers, machinery, and equipment of a vast variety. The chemical engineer predominates in the processing branch of the industry, but he also is carving niches for himself in research and production.

Several companies, however, make very little distinction between branches of the engineering sciences.

One said it needed technically trained people from all the sciences. The representative of another big employer said flatly: "We are interested in recruiting men from all branches of engineering. It is our policy to hire the better engineers from accredited schools and train them on the job to handle our various engineering functions."

"In other words," he said, "We like to hire men out of schools that have good basic engineering and basic science courses. We place more emphasis on this than on their extensive applied engineering courses. Applied engineering is useful to a degree, but a great deal of the application can be obtained on the job whereas the basic fundamentals are not likely to be developed on the job."

Dean R. L. Langenheim of the University of Tulsa engineering school said educators were aware of the need for grounding students in basic engineering principles. He said the various engineering specialties actually were the products of packaging basic courses.

The chemical engineer just has a little more chemistry than some of his colleagues. The petroleum engineer has more geology and production training. But any good student well grounded in mathematics, chemistry, physics should be able with a little digging to make a quick adjustment in another branch of engineering work, he said.

Experience also wanted . . . The postwar shortage of engineers has spotlighted the importance of the young engineering graduate.

He has been sought after like a pretty belle at the ball. His pay has shot up phenomenally.

The result has been some discontent in the ranks of the older, more experienced engineers. Their pay hasn't risen so dizzily. They often feel they have been shunted into routine work that a technician could handle as well. They openly say their talents and experience are not being used or rewarded.

This situation undoubtedly has been true in many cases. But there are indications a change is taking place which will correct this.

In fact, one company told Journal editors it was slacking up on hiring graduates and was cutting down recruiting trips to colleges. Instead, it was going into the market for experienced engineers.

The reason: "We can evaluate experience much better than inexperience."

This company, the chief engineer reported, in the past has hired real good looking graduates fresh out of school who have flopped miserably when it came to doing some real engineering thinking on actual problems.

"Our batting average hasn't been very good with such beginners," he said. "The expense of training a grad-

What Oil Engineers in Houston Are Paid

	Minimum	Maximum	July 1957 median	July 1956 median
Pipelining—				
Engineer, beginning	$460	$521	$490.50	.....
Engineer, 2-3 years' experience	504	613	558.50	.....
Engineer, after 3 years	549.08	953	751.04	590.08
Production—				
Engineer, beginning	460	565	512.50	489
Engineer, 2-3 years' experience	504	722	613	557.50
Engineer, after 3 years	530	790	660	643
Refining—				
Engineer, beginning	435.50	631	533.25	481.50
Engineer, 2-3 years' experience	530	709	619.50	537.50
Engineer, after 3 years	540	815	677.50	645
Equipment Manufacturing—				
Engineer, beginning	400	550	475	450
Engineer, 2-3 years' experience	487	620	553.50	510.50
Engineer, after 3 years	525	1,313	919	867.50

Source: Houston Chamber of Commerce survey.

Future engineers like these students conferring with their professors at University of Tulsa are jamming American schools of engineering. But as number of engineers grows, demand for their services expands even more. Round-table conference above includes Richard Nelson, Joe Johnson, Vernon Webb, Dean R. L. Langenheim, Donald Farley, Allen White, Warren Breiner, and Prof. H. N. Carter.

uate for a year before we can find out if he will be able to help has made us look for experienced men."

Another oil company recruiter said there is a heavy demand for all technical people by integrated oil companies. That's true for recent graduates as well as experienced people. He said there were fewer experienced men on the labor market, but his company hoped to pick up talent which is leaving some of the defense industries.

This recruiter commented his company doesn't often lose an experienced engineer from its staff. "But when we do," he said, "it's usually to a small oil company rather than to the majors. Often the small companies demand experience. Since they don't have to respect a company-wide salary structure, they will pay more for proven talent."

Another personnel man just about summed up the value of experience to engineers. He said: "What many young graduates don't realize is that engineering is more than a science. The good engineer also has imagination and some creative talent in approaching problems. This often develops through experience on the job."

The general rule holds true, however, that most oil companies seek out the recent graduates for new jobs, although taking on an older man occasionally. They want the engineer in his formative years where company training will upgrade him the most.

Paychecks: The big lure . . . The starting engineer leads the parade in the pay he receives.

The average young engineer entering the oil industry in 1955 made $5,525 a year or about $460 monthly. Averages climbed, and by the time the 1957 class went to work, starting pay generally was about $470 to $475 monthly compared with a $433 monthly average for engineers in other industries.

Most oil company personnel people told the Journal starting pay for engineers probably will rise again to about $485 monthly in 1958.

Pay scales vary all over the oil patch. Companies are reluctant to reveal wage policies, but these cases obtained apparently are typical for 1957:

Company 1—$420 monthly starting pay which automatically goes to $500 after first year of training. Salary spread from 1-year man to experienced engineers $6,000 to $15,000. The $15,000-a-year man is approaching management level.

Company 2—$475 monthly starter for man with one B.S. degree, $500 for two B.S. degrees, and $525 for M.S. degree. Pay for men holding doctorates depends on the individual, and no scale is set.

Company 3 — $470 monthly for starter, rising to $610 after 3 years. Spread from fledgling to experienced engineer is $5,640 to $21,600 annually. The $21,600-a-year man, however, is a division engineer and usually has started up the management ladder.

Company 4 — $465 for average starter with $485-490 for electrical and electronics engineers.

Company 5—$460 to $505 depending on degree of graduate.

Company 6—$525 for chemical engineers, slightly less for others.

Fast start . . . The beginning engineer is far ahead of the average graduate in starting pay.

While the fledgling engineer in 1957 was averaging $433 monthly and much higher in the oil industry, here's what his classmates got as starting pay: Accounting, $389; sales, $385; business trainees, $382; and other fields, $414.

By way of comparison, the story for 1956 graduates' starting pay was: Engineering, $415; accounting, $372; sales, $370; business trainees, $363; other fields, $394.

The parade changes, however, after 10 years out of college. Recent studies show that men in the nonengineering fields earn more then. After 5 years the typical engineer will be passed by the salesman but still will be ahead

of the average accountant or general business trainee. After 10 years the engineer will be in fourth place. His average pay will be $8,880 a year compared with $9,912 made by the average salesman.

A Northwestern University study attempts to explain this shift in pay structures. It reported that after the first years of training nonengineering men "progress on merit and some move forward much more rapidly than others. The increased administrative responsibility accounts for some of the higher salaries in nontechnical fields."

Story on older men . . . One source of complaints among experienced engineers is that their pay has not kept pace with that of the beginners.

Average pay of experienced engineers has closely followed oil companies' general pay increases. Last year, for instance, most oil companies reported engineering salaries moved up from 6 to 17 per cent. This does not include merit increases granted in individual cases. Pay is expected to move up again in 1958.

One student of the problem gave this reason for discrepancy between starting pay and wages received by older engineers: "Our real shortage seems to be in the ranks of junior engineers. The supply of older engineers is not so critical with the result they have far less bargaining power."

In the mid-30's an engineer with 20 years' experience earned about four times as much as a beginner. In most instances today the ratio is not much over twice as much in favor of the 20-year man.

The result is that many engineers move into management, administrative, or sales jobs with their companies in order to hit the higher pay brackets. This is particularly true in the oil industry, where many of the top executives rose from engineering ranks.

In fact, most of the oil companies contacted by the Journal reported the management field offered one of the prime opportunities of advancement for young engineers. They pointed out there is a shortage of managers as well as engineers and noted that the engineer's technical training often suited him well in a management job.

Engineers wasted . . . Many company executives, however, are questioning the merits of forcing engineers to go into management posts for higher pay.

Engineering jobs paying above $12,000 a year are scarce. Top pay scales that engineers who do not go into management can expect range from $15,000 to $18,000.

The answer often proposed now is that salaries of creative and talented specialists should rise to the point where management jobs wouldn't lure them. Many sound engineers are not suited for administrative posts by background, training, or inclination.

One oil company is just starting a plan to evaluate performances of its employes, including engineers, with an eye to promotions and salary increases. Other companies already have similar systems.

The perfect answer may never be found. While one executive said the answer is to let engineers do engineering, another said management is just as shorthanded as engineering sections. A likely management man in the engineering ranks might do more for the company as an administrator than he could doing engineering, he said.

The outlook . . . No matter whether the engineer follows his profession or moves into management, one fact appears certain in the future: The demand for technically trained men in the oil industry will remain heavy.

Lury B. Redmond, personnel manager for Magnolia Petroleum Co. put it this way: "Oil has jumped headfirst into practically every new branch of science developed in the past decade. It has an enormous demand for top-flight young people in nearly every technical specialty."

Redmond said the future potential for engineers could easily be seen by considering oil industry plans: Oil is going into electronics on a vast scale. The industry is experimenting with atomic energy in everything from exploration to marketing. It is using computers in a tremendous number of new ways. And as always officials are looking for potential management talent in the engineering ranks.

Glenn Stearns, chief engineer for British-American Oil Producing Co., said he expects his company's needs for engineers to continue a gradual increase. Stearns doubted that increased enrollment in engineering schools will result in enough graduates to keep pace with the demand.

Dr. Gordon K. Teal, assistant vice president of research, Texas Instruments, Inc., Dallas, said a present shortage existed for 45,000 to 50,000 engineer specialists. He predicted the shortage will grow to 80,000 or 100,000 by 1960.

Every oil company contacted by the Journal reported it felt the oil industry's need for engineers will go on up in the future. Many already are financing educational programs to interest more high-school students in science, to help high-school science teachers financially, and to help college engineering departments both by grants and scholarships.

Oil companies also have inaugurated expensive training programs both for their beginning engineers and for more experienced men. The training for the beginners is more formal. They are given an orientation in nearly every phase of the company's activities. Training for experienced men usually takes the form of a variety of job assignments, under expert supervision, until promotion to an administrative level is reached.

One official summed up the approach to the training programs this way: The engineer and the company both have a stake in a man's growth. If a fellow's knowledge isn't broadened, he can become obsolete in engineering in only a few years.

Another said: "We have a tremendous job just keeping up with the improvements coming along every day. We are going to be looking for people that can help us do it. I imagine other oil companies are doing the same."

A.S.M.E. head asks:

Who is an engineer?

HARTFORD. — The engineering profession is bursting at the seams and will fly apart unless steps are taken to analyze problems facing the profession and remedy them.

That opinion was expressed last week by William F. Ryan, president of the American Society of Mechanical Engineers, at a fall meeting of the group here. He repeated pleas for support of a detailed survey of the entire engineering profession. Dr. Ryan said the survey would suggest solutions to these problems plaguing engineers for years: Lack of group consciousness, lack of an accepted code of ethics, confused state registration laws, lack of genuine legal status, and problems in education.

Dr. Ryan declared that many people, including engineers, could not define an engineer or his job, often confusing members of the profession with draftsmen and technicians.

"Perhaps when we find out who is an engineer and what he does, and we undertake to let him do it, we will find that the shortage of engineers is not so great as we have feared," Dr. Ryan said.

Import Ruling Awaited

Some adjustments in quotas believed coming, but the big question is: How tough will Government enforcement be?

WASHINGTON. — Importers last week were asking: How tough is the Government going to be in enforcing the voluntary control program?

The answer will come in a matter of days. It'll be implied in the first decisions on seven appeals for higher quotas. These rulings will be dictated by the cabinet committee that wrote the program.

Interior Secretary Fred A. Seaton, middleman between the committee and Capt. M. V. Carson, Jr., administrator, has made it clear that the appeals will be decided only after talks on the highest level.

Both Seaton and Carson are confident, however, that despite any adjustments in quotas the program will be a success. Seaton predicted that the companies will meet their quotas or be so close "as to make no difference."

Cooperation seen . . . The two officials discounted warnings by Gulf Oil Corp. that quota revisions might set off a chain reaction that could wreck the program (OGJ, Sept. 23, p. 66).

They held that no company really has challenged the program, although some statements have been so construed in some quarters.

Seaton disclosed that J. E. Dyer, president of Sinclair Refining Co., had phoned Carson to say he was disturbed by reports in some newspapers that the company had "defied" the Government. There was no such intention in anything he said, he declared.

Seaton said flatly that he looks for the companies to go along with the program.

"I personally expect the importers to so arrange their affairs that they can cooperate," he said at a news conference.

What can happen . . . If the companies don't get into line, Seaton pointed out, there are only three alternatives:

. . . Do nothing, which is unthinkable.

. . . Ask the President to act under the national security clause of the Reciprocal Trade Act.

. . . Or wait for Congress to move in.

"I would assume that the companies would vastly prefer voluntary action to mandatory controls," the secretary commented.

Carson now is winding up his study of the arguments offered by protesting companies earlier this month. He will lay the first of his reports and recommendations before Seaton this week. Seaton, in turn, will consult Mobilization Director Gordon Gray and the cabinet committee before passing on Carson's findings.

Of the seven cases to be decided, that of Tidewater Oil Co. is seen as raising the most serious problem.

Tidewater closed its Bayonne refinery in 1954 and did not get its replacement in Delaware on stream until early this year. It had planned to import 84,600 bbl. daily for the new plant. But since its imports last year averaged only 22,200 bbl. daily, it was given a quota of 34,200 bbl.

The company contended that the 50,400-bbl. cut in imports would endanger its $200 million investment in the new plant. It asked for a quota of 62,000 bbl. daily, the minimum, it said, on which it could operate competitively.

Adjustments . . . It is expected that some adjustment may be made for Tidewater.

Some others in the group also may receive consideration. But one, two or more may find themselves frozen to the quotas assigned them.

Gulf's protest against revisions, sent individually to the seven appealing companies, met a cool reception among the latter.

Richard B. Kahle, president of Eastern States Petroleum & Chemical Co., invited by Carson to reply, said there is "nothing to be gained" by argument with Gulf.

John E. Swearingen, executive vice president of Standard Oil Co. (Ind.), also refused to comment on Gulf's letter.

Swearingen, however, took occasion to launch a new attack on the historical basis of allocations as "inequitable and discriminatory."

He repeated arguments presented at the hearing that it would be fairer to limit refinery use of foreign crude to 9.6 per cent of domestic production.

"Our suggestion gives recognition to historical imports, but in time would result in equitable allocations," Swearingen wrote.

"The present program should be directed toward competitive equality rather than preserving historical position, especially where freezing historical position would progressively enhance competitive advantage," Swearingen said in his letter to Carson.

Division in ranks . . . Domestic producers, meanwhile, have split over the probable effectiveness of the voluntary program.

The Independent Petroleum Association of America commended the plan as "a long and important step toward a sound and lasting solution" to the problem of imports, Robert L. Wood, president, wrote Carson.

But Jerome J. O'Brien, president of the Texas Independent Producers and Royalty Owners Association, told a meeting of the federal bar association that the voluntary approach "has never proved adequate during its many trials by the ODM."

A tariff on foreign oil is the "most practical and equitable means" of restricting imports, O'Brien said.

"It would involve no iron-clad quotas and would jeopardize no company's competitive position," he declared.

Imports Backfire:

Credit Cards Suffer In Proration Fight

SANTA FE, N. M.—Gov. Edwin L. Mechem has taken an unusual step in dealing with Gulf Oil Corp.'s purchaser proration in New Mexico.

The governor called in Gulf dealer credit cards issued to state offices and departments under his jurisdiction. The dealers protested by sending a stack of wires and letters to the governor's office. Governor Mechem suggested the dealers "get in touch with the home office in Pittsburgh."

Gulf began purchaser proration in New Mexico and other states in August. The company cut purchases in New Mexico by 20 per cent.

Magnolia Oil Co. also cut purchases in New Mexico in June, and is now taking about 76.5 per cent of May purchases. Governor Mecham said that he might also call in Magnolia dealer credit cards.

"It could get to the point of elimination of purchases from importers," the governor said.

At a hearing earlier this month, a Gulf spokesman told the commission that "we don't like purchaser proration either, and are going to end it as soon as we can—as soon as we are able to reduce our excessive stocks."

Sunshine Sells Oil

Washington well going on production, offset ready

EVERETT, Wash. — Washington's first commercial oil well, Sunshine Mining Co.'s 1 Medina, was getting ready to go on full production late last week. And an offset is scheduled to start drilling this week or next.

Sunshine reported it has negotiated a crude contract with a northwest refiner, but it isn't saying which one until the contract has been signed.

The first extension to spud in will be 1 Beach, about 1,200 ft. south of the discovery. Sunshine has staked two other offsets.

Sunshine has set the potential of 1 Medina at 220 bbl. a day (OGJ, Aug. 26, p. 75), based on a flow of 140 bbl. of oil in 15 hours, the last test the company reported.

The 1 Medina was completed in the second of three Nye zones found in the 4,130-ft. wildcat. For completion, four holes per foot were shot in the interval 3,952-58 ft. Location is in the Ocean City area of Grays Harbor County.

Leases sold . . . Meanwhile, acreage 35 miles north of the 1 Medina brought $6.60 an acre at a lease sale. Bids ranged down to 1 cent an acre.

Donal A. Carty of North Hollywood, Calif., turned in the high bid, which covered 285.11 acres on the Quinault Indian reservation. The land was offered in four parcels, three in Jefferson County and one in neighboring Grays Harbor County. The acreage is 4 miles from the coast.

Texas Well Goes Deeper

FORT STOCKTON, Tex.—Pan American Petroleum Corp. tacked another 500 ft. onto the contract drilling depth of its record-breaking Pecos County, West Texas, deep test last week and continued to bore on down.

The rank wildcat, the 1-CS University, at mid-week had reached 20,704 ft. Its 20,500-ft. contract was amended to 21,000 ft.

At last week's depth the 1 University was still in the Barnett shale of the Mississippian and aiming for the Devonian. For the past 40 days, it has averaged about 25 ft. of hole a day.

Setting a new Texas depth record every day, the deep test last week was 1,644 ft. deeper than the previous record holder. This was Magnolia Petroleum Co.'s 417-A West Ranch in Jackson County on the Gulf Coast which went to 19,060 ft. in 1955.

watching WASHINGTON

. . . with Bertram F. Linz

How's the consent decree?

NEXT in the Washington spotlight—oil pipelines.

The Justice Department has been talking for several months about suits against a number of lines. So far, it hasn't gone into court, however.

But 3 weeks from now the House antitrust subcommittee will get into the picture. A 4-day hearing is planned to find out how the 1941 consent decree is working.

Both the department and the subcommittee are interested primarily in the profit angle. The consent decree limits the return an oil-company owner can collect from common-carrier pipeline operations.

The idea back of the recent moves is that the parent companies may be taking more from the lines than the 7 per cent allowed.

Justice officials are expected to be the first witnesses at the upcoming hearings. They will be questioned, first, about the profit situation as they have found it and, second, why they haven't done something about it.

After winding up the pipeline study, the probe will go into the enforcement of consent decrees in other industries. This, too, might spell trouble for some oil companies.

New rules for offshore?

HERE'S a switch: A congressional committee is going to make an investigation that may help rather than hurt the oil industry.

A five-man House group is doing the spadework for a study of the problems oil operators run into when they drill in the Continental Shelf. Offshore operators may soon be called in to furnish information.

Many problems have sprung up in the 3 years the industry has been wading in federal waters. But even more are seen as likely to come up in the future.

A quick survey shows that hard questions are arising in contract law in connection with drilling and building operations. There are serious questions of workmen's compensation and more in the field of insurance. And there is the question of double jeopardy in criminal law over violations committed on the high seas, of which the shelf is a part.

Rep. Edwin E. Willis of Louisiana, chairman of the group, believes that some changes in federal laws may have to be made to clear these matters up. So it's not likely that any bill will be passed next year. But one is likely to be offered in 1959.

Another slice of Alaska?

THE long-deferred "liberation" of more than 20 million acres of potential oil lands in Alaska may finally be in sight.

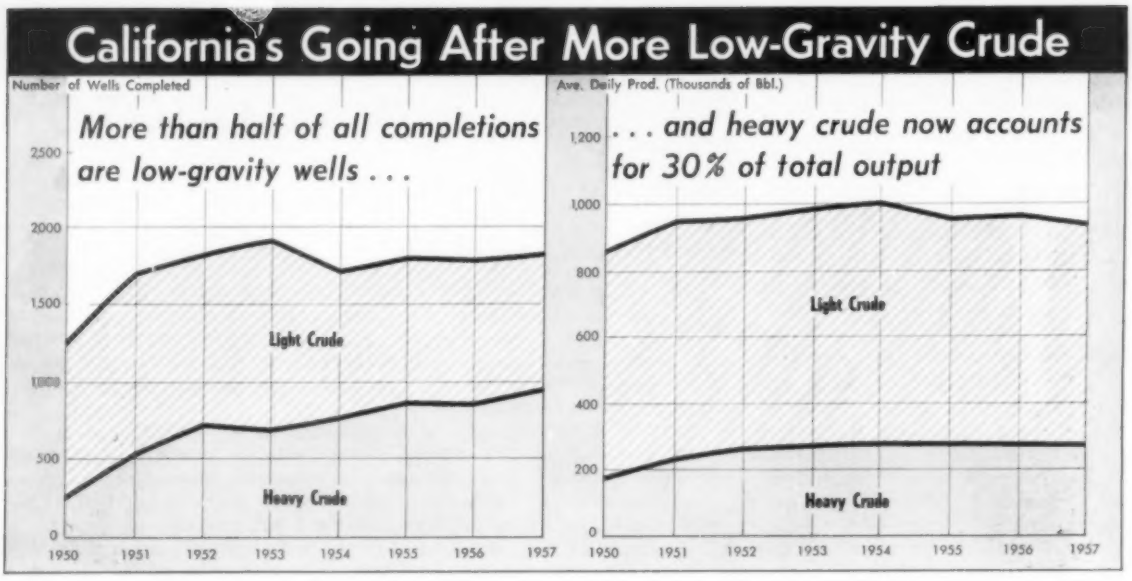
Interior Secretary Fred A. Seaton is expected to make a decision in the next few weeks. But there is some question whether the whole area will be released or just enough of it to enable development of the Gubik gas field (estimated reserve 300 billion cubic feet) and a pipeline to Fairbanks.

This little patch of Alaskan land has been tied up since 1943 under Public Land Order 82. The idea was that if the Navy found oil in its own 25-million-acre reserve it would also explore the adjacent area.

The Navy pulled out in 1953 and former Interior Secretary Douglas McKay proposed to release the area to private development. But McKay asked for congressional support and the plan never went through.

Seaton, however, feels he doesn't have to ask Congress to let him act. The authority, he says, is in his department. If Congress wants to go into the matter after he acts it is free to do so.

The Navy has agreed to repeal of Order 82. Seaton has assured it that he will take no action endangering the oil reserve itself.



It's a Comeback for Heavier Crudes

A DECLINE in light-crude production in California's oil fields has created new demand for heavy crude to supply the West Coast's growing appetite for petroleum.

The new demand, coupled new refining developments, has stabilized the heavy-crude market and given part of the California oil industry a much-needed shot in the arm.

California historically is a heavy-crude producing area, but in the past the demand has varied from one extreme to the other. At times the market has been bullish; at others, the demand has been so low that thousands of wells were shut in.

Today low-gravity crude production is on the rise—and so is the demand. Here's what is happening:

. . . **Light crude** production has declined steadily since 1953. In '53 light crude peaked at an average of 733,000 bbl. daily. Last year the average was down to 663,500.

. . . **Heavy-crude** (below 20°-gravity) production increased from 182,618 bbl. daily in 1950 to 272,794 bbl. at the first of this year. In 1950, heavy-crude accounted for 21 per cent of California's total production; today it's about 30 per cent (see chart).

. . . **Drilling** for low-gravity crude has increased, while drilling is down in higher-gravity fields. In 1950, heavy-crude well completions accounted for only 19 per cent of the state's total. This year they will exceed 50 per cent (see chart).

. . . **Low-gravity crudes** are holding their own in total reserves, while higher-gravity crudes are not. In 1951 low-gravity reserves amounted to 1.5 billion barrels, or 35 per cent of the total reserves. This year the reserves were about the same but accounted for 38 per cent of the total.

Refinery angle . . . Petroleum processing developments also have affected heavy crude production and demand.

. . . **Improved techniques,** such as coking, have cut down residual yields of crude runs from 38 per cent in 1951 to 31 per cent last year. This has helped stabilize the residual fuel market by reducing the output per barrel. The result: supply and demand are in better balance.

Coking capacity in California has grown from 39,000 bbl. daily to 100,000 since 1954.

. . . **The demand** for higher octane gasoline has resulted in more severe reforming, and this means less gasoline per barrel. To meet the demand for gasoline, refineries therefore must have more crude.

Fuel-oil picture . . . The residual-oil market is tied closely to production of heavy crudes.

Formerly, there were occasional surpluses of fuel oil because refineries had less severe processing units for their heavy-crude charges. This was aggravated in recent years by a rapid increase in use of natural gas for industry.

One of the worst cases of fuel oil surplus occurred in late 1949 and early 1950 when stocks reached 40,000,000 bbl. The condition resulted from a record number—1,145—of well completions in low-gravity fields in 1948.

The market glut was partially eased by shutting in about 3,000-low-gravity producers and by distress shipments to the East Coast. Normal inventory was not reached until the Korean conflict increased demand.

Another surplus occurred in 1954-55. In November 1954, fuel-oil stocks had reached 30,000,000 bbl., compared with the normal level of 17,000,000. Large distress shipments again headed east.

By December 1955, stocks were down to 11,954,000, and since then they have been building up until they have returned today to the normal level of 17,000,000. And the peak use period is just starting.

Better prices now . . . The new stability in the fuel-oil market has been accompanied by a substantial increase in price for heavy-crude grades. The spread between heavy and light crudes has been cut, and the two now are in a sound relationship.

Price changes in the heavy-crude Gato Ridge field of Santa Barbara and the light-crude Montebello field of the Los Angeles basin show what has happened.

In 1953, Gato Ridge 12°-gravity crude brought only $1.42 per barrel. Today it sells for $2.28, a 60 per cent increase. In the same period, Montebello 40°-gravity increased from $3.53 to $3.71, only 5 per cent.

The gap between high and low gravity prices has closed even within individual fields. At Montebello the

price spread between 14°-gravity and 40°-gravity crude was $1.56 in 1953 but is only $1.01 today.

Production boosters . . . Heavy-crude production has increased in California not only because of increased drilling but also because of secondary-recovery techniques.

California's low-gravity fields lend themselves more rapidly to secondary recovery than do light-gravity fields. For one thing, the percentage of primary recovery of oil is lower in the heavy-crude fields.

Also the shallower depths of the heavy-crude fields make them more attractive economically for both secondary recovery and for infill drilling. Activity in some of California's oldest fields—Kern River, Midway-Sunset, and others—has been increasingly heavy in recent months because of infill drilling programs.

The growing use and success of bottom-hole heaters also has contributed to the state's heavy-crude production. Some 700 to 800 heaters have increased output by about 8,000 bbl. per day.

Sunray's 80-acre bid opposed as . . .

. . . Bisti Spacing Fuss Flares

SANTA FE, N. M.—Operators in Bisti field are divided on whether to set up 80-acre or 40-acre spacing for the big northwestern New Mexico pool.

Sunray Mid-Continent Oil Co. ran headlong into opposition when it asked the New Mexico Oil Conservation Commission for temporary 80-acre spacing on a 1-year trial basis.

The opposition came mostly from Shell Oil Co. and Gulf Oil Corp., which would both like to see 40-acre spacing at Bisti. After 2 days of hearings the commission took the case under advisement.

Sunray's application is supported by most of the operators in the 134-well field, including British-American Oil Producing Co., Humble Oil & Refining Co., Amerada Petroleum Corp., Sun Oil Co., and El Paso Natural Gas Co.

Conflicting testimony . . . Sunray testified that about 10,000 acres are already developed on an 80-acre basis and that Shell's plan to drill four 40-acre locations "constitutes a serious threat to our present voluntary 80-acre density."

Sunray considers the reservoir a solution gas-drive field. It produces from five sand members of the lower Gallup formation at about 4,800-5,000 ft. The company believes the Gallup formation is continuous throughout the area.

Shell's testimony contradicted Sunray's findings. Shell contends that the permeable sands at Bisti are irregular and not continuous and that the field does not have a gas cap.

Describing the reservoir as heterogeneous, Shell witnesses said the Gallup sands are irregularly distributed, located in different stratigraphic positions from well to well, and not evenly bedded.

"If it is not drilled on denser spacing pattern, much of the recoverable oil will be left in the ground," Shell attorney Oliver Seth said.

Sunray testified that 40-acre spacing would be only a "break-even" proposition, financially. Shell said 40-acre spacing would return sufficient profit.

Secondary recovery . . . Bisti, which is only 2 years old, is already undergoing its first secondary-recovery project. In August, Sunray began injecting L.P.G. into a pilot area.

The company injected 30,000 bbl. of L.P.G. into the reservoir and last week was scheduled to begin injection of dry gas.

The operator hopes that the L.P.G. flood will recover 60 to 70 per cent of the field's estimated 100,000,000 bbl. of oil in place. This is more than double an estimated 25 per cent recovery by primary means (OGJ, July 22, p. 51).

Sunray testified that close spacing would hamper ultimate recovery. On the other hand, Shell believes that "in view of discontinuities and irregularities" in the reservoir, efficient sweepout could not be achieved on wide spacing.

Stumbling block . . . Bisti operators have been hampered by lack of outlet. Although most of the wells were completed flowing 100 to 700 bbl. of oil daily, production is now limited to about 7 bbl. per day per well, which is sold to El Paso Natural for local refining.

But outlet problems will be relieved with the advent of two new crude lines in the Four Corners area. Four Corners Pipe Line Co. expects to complete a 16-in. line to Los Angeles early next year. And Texas-New Mexico Pipe Line Co. is building a 16-in. line to Jal in southeastern New Mexico.

——— *Industry* briefs

Oklahoma's crude-oil allowable has been held to 600,000 bbl. daily for October—the same as for September. Because of pipeline proration, actual production for September has been running about 575,000 bbl. At the corporation commission's market-demand hearing, two prorating firms urged an allowable cut, but others called for no change or made no recommendation at all.

Louisiana has kept its October crude allowable at the September level except for a 17,260-bbl. daily increase for new production. The allowable total was fixed at 777,428 bbl., but extensive pipeline proration may cut actual production below that figure. Louisiana reduced its allowable four consecutive months after the Suez crisis eased. During the crisis the allowable topped 1,000,000 bbl.

The Texas Co. will add six new 46,000-ton tankers to its fleet. The ships will be designed for speeds of 16½ knots, and will be used in Texaco's foreign service. Contracts for the proposed tankers have not been awarded yet.

Top Hollywood stars, directors, and writers will help tell the story of oil's first hundred years. Metro-Goldwyn-Mayer studios has been selected by the American Petroleum Institute to produce the first of a series of 1-hour color films for television as part of the centennial celebration in 1959. The film, scheduled for national network release, will be "Centennial."

White Star Oil Co., Oklahoma City, has acquired interest in 10,500 acres of mineral rights near Sunshine Mining Co.'s new discovery in Grays Harbor County, Washington. The company, formerly known as Holiday Oil & Gas Corp., is opening a new office in Aberdeen, Wash.

White Star's new leasehold interests came about through acquisition of Utah Consolidated Oil Co., which holds substantial interest offsetting the new Washington discovery. The deal also included Utah Consolidated's wholly owned subsidiary, North Coast Drilling Co., which operates a rotary rig near Ocean City, Wash. In another deal, White Star acquired Hallmark Petroleum & Drilling Co., adding four rigs to the company's equipment.

Double jointer cuts costs as . . .

New Unit Speeds Pipe Laying

TULSA.—Speeding up pipe laying is usually a good way to cut construction costs. And double jointing is a step toward getting faster pipe laying in fairly flat prairie country.

The latest advances in double-jointing techniques were demonstrated here last week during the A.S.M.E. conference.

These advances are incorporated in a unit called the Crose-Price-O-Matic double jointer, equipped with fully automatic heads for welding by submerged arc, outside and inside pipe. The maximum in automation is used for pipe handling, lineup, and rotary. The unit is a product of the joint efforts of H. C. Price Co. and M. J. Crose Manufacturing Co.

The value of this unit is indicated by a possible increase of $16,800 per day gross income. This could come where a contractor's spread would be laying 30-in. pipe for $3.50 per foot across prairie country.

When laying 40-ft. pipe of 200 lineups totaling 8,000 ft. per day, gross income would be $28,000. But with 80-ft. pipe produced at such a double-jointing yard, pipe-gang output with 160 lineups per day making 12,800 ft. would give a gross income of $44,800 per day.

How it works . . . Faster operation of the new double jointer is accomplished by new hydraulic and electric pipe-handling features and by the increased efficiency of fully automatic heads. Entire personnel consists of only 16 men.

Pipe is rolled on skidways first to the grinding station where 75 per cent of the bevel is ground off by special electric-powered (360-cycle) grinding units.

Then it goes to the welding station where it is manually tack-welded for 2-in. at the bottom, and lineup is completed by a new technique. Two outside beads are run by automatic submerged arc welding. Then it is rolled to the next rack for the inside bead. Both outside and inside beads are run by Automatic Lincoln L.A.F. 3 submerged arc-welding beads.

The whole technique is an important step ahead of the usual submerged arc pipe welding method where the first bead is commonly run manually.

Terminal Work Begins

LOS ANGELES.—The city of Los Angeles is building the West Coast's first supertanker terminal in Los Angeles harbor. The terminal will be in the outer harbor at the foot of Miner Street in San Pedro.

Construction of the 1,100-ft. moorage is already under way, with completion set for January 1959. A turning channel 50 ft. deep is planned.

Supertankers must now unload either at Wilshire Oil Co.'s marine line at Huntington Beach, or Standard Oil Co. of California's two marine lines at El Segundo.

Octane Count Up

Premium rating bounces back to high June level

PREMIUM OCTANE rating bounced back to its record high of 98.2 numbers, after a slight seasonal slump which began early in the summer.

The September rating for premium was 0.1 above the August average. But the average for regular was still at 90.9, the same as August and 0.1 below June's record high of 91 numbers.

During the first 6 months of this year, premium climbed rapidly, from 97.4 to 98.2. In the same period, regular climbed from 90.5 to 91 numbers in June. The leveling off trend began in July.

Compared with a year ago, September's premium average was up a total of 1.2 octanes, and regular showed a 0.8 increase.

One significant trend continued in September—the increasing number of suppliers marketing premium in the 99-99.9 range. There were 21 suppliers in this category, as compared with only 19 in August.

Also significant in the September survey was the increase in the average rating of superpremium brands tested by Ethyl Corp. The 34 samples averaged slightly more than 100.9 octane. This compares with 100.3 in August.

PREMIUM
(Cities per octane group)

	Sept. 1957	Aug. 1957	Sept. 1956
93-93.9	0	0	1
94-94.9	1	1	3
95-95.9	1	2	3
96-96.9	2	0	19
97-97.9	9	12	25
98-98.9	42	40	2
99-99.9	2	2	2
Total cities	57	57	55
Weighted avg. R.O.N.	98.2	98.1	97.0
Weighted avg. TEL, ml./gal.	2.59	2.62	2.59

REGULAR
(Cities per octane group)

82-82.9	0	0	1
83-83.9	0	0	0
84-84.9	1	1	0
85-85.9	0	0	1
86-86.9	0	1	5
87-87.9	4	2	7
88-88.9	11	10	8
89-89.9	17	18	13
90-90.9	4	5	2
91-91.9	4	6	9
92-92.9	13	14	7
93-93.9	3	0	0
Total cities	57	57	53
Weighted avg. R.O.N.	90.9	90.9	90.1
Weighted avg. TEL, ml./gal.	2.24	2.19	2.31

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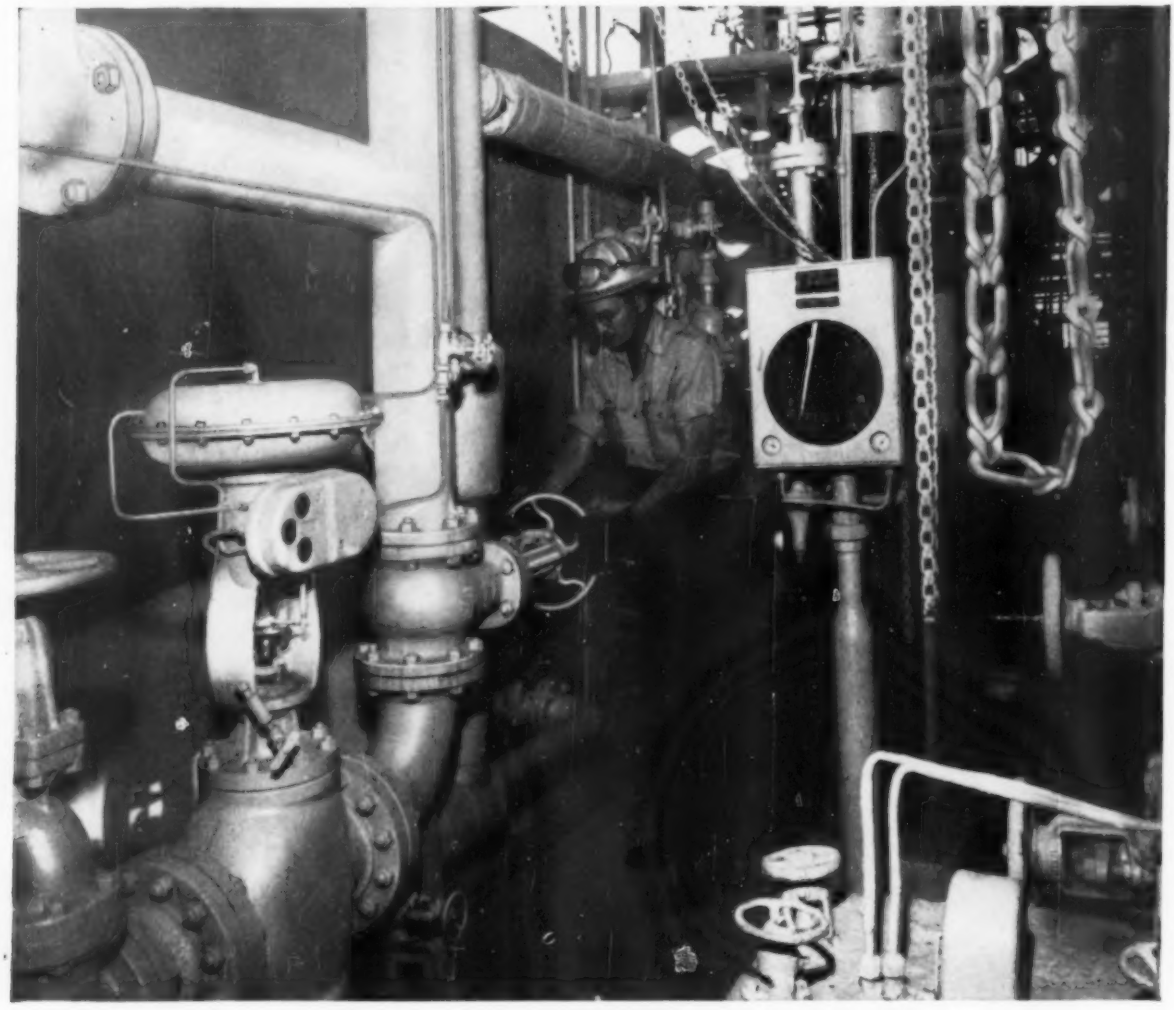
Refinery proves economy of CRANE Steel Gate Valves



Handle corrosive fluids 2 years without leaking

Cities Service Refining Corporation, Lake Charles, La., knows that gasoline, mixed with hypochlorite, can be rough on steel valves. Such a corrosive mixture can cause leaks in a relatively short time.

So, about two years ago, a Crane No. 47-X cast steel wedge gate valve was installed in the line to the regulator at the settler drum in the product treating plant. This valve is operated four or five times yearly. It closes tightly every time. To date, no leaks have occurred. No maintenance has been necessary.

If you are seeking better service from steel wedge gate valves in your plant, why not look into the economies Crane valves offer you?

Ask your Crane Representative to give you the facts about the features of Crane steel gates that make them have longer, maintenance-free lives.

IDEAS FOR YOU. Ask your Crane Man or write to the address below for a copy of "Valve Performance Facts"—a 36-page circular about the performance of Crane valves under varying service conditions.

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Alberta Crude Falls

● Demand lowest in 28 months because of strike, inventories, turnarounds

CALGARY.—A labor strike, high inventories, and refinery turnarounds have cut Alberta nominations to their lowest level in more than 2 years.

The Alberta Oil and Gas Conservation Board has approved November nominations of 310,148 bbl. daily. This is 37,894 bbl. below September's demand.

Officials gave these reasons for low nominations:

. . . **Workers** at the Imperial Oil, Ltd., refinery in Vancouver went on strike last week. The plant usually takes from 20,000 to 30,000 bbl. of crude daily. No nominations will be made until the strike ends. The main issue concerns effective date of a pay increase offered workers last March. Differences on overtime also are involved. Negotiations are being conducted with the Oil, Chemical and Atomic Workers local.

. . . **Turnaround** in some refineries is continuing, cutting down purchases temporarily.

. . . **Inventories** of refined products are very high in Ontario. But plant turnarounds will probably deplete this inventory quickly.

Who bought what . . . Refineries in the United States want 77,944 bbl. daily. General Petroleum Corp. was the biggest U. S. purchaser, with a bid for 34,048 bbl. daily. Shell Oil Co.'s Anacortes, Wash., plant will take 30,000 bbl. daily.

Imperial is usually the leading purchaser. But new nominations were cut to 60,400 bbl. daily because of the strike. British American Oil Co., Ltd., is first-place purchaser with 65,730 bbl. daily.

About 78 per cent of the oil will move through the Interprovincial and Trans Mountain pipelines.

Nominations from U. S. refineries are as follows:

General Petroleum Corp., Ferndale, Wash.	34,048
Shell Oil Co., Anacortes, Wash.	30,000
Lake Superior Refining Co., Superior, Wis.	5,161
International Refineries, Inc., Wrenshall, Minn.	4,839
Bay Refining Corp., Bay City, Mich.	3,000
Dow Chemical Co., Midland, Mich.	323
West Branch Refineries, West Branch, Mich.	323
Union Oil Co. of California, Cut Bank, Mont.	250
Total	77,944

Pipeline briefs

Texas-New Mexico Pipe Line Co. has let contract for construction of two pump stations on its 512-mile, 16-in. crude line being built between Aneth, Utah, and Jal, N. M.

Contractor is Station Construction Co. of Houston. Stations involved will be in the Bisti, N. M., and Aneth areas. They will be equipped with high-speed centrifugal pumps and 1,100-hp. diesel engines. The contractor also will lay concrete ring foundations for three 78,400-bbl. crude storage tanks at Aneth.

Gibson Petroleum Co., Ltd., has the go-ahead from the Alberta Government to build a crude line from Willesden Green field to a pump station at Texaco Exploration Co.'s pipeline near Rimbey, about 25 miles east of Willesden Green. This will be the second crude line for the pool. Recently Pembina Pipeline, Ltd., extended its pipeline facilities at Pembina pool to serve Willesden Green and Keystone fields.

Inland Natural Gas Co., Ltd., is nearing completion of its 329-mile natural-gas line from Savona to Nelson, B. C. The project includes 304 miles of mainline and 25 miles of laterals. The new carrier will serve 31 towns and will receive its supply of natural gas from the Westcoast Transmission Co., Ltd., gas line at Savona. Completion was scheduled for late September or early October.

A $53.7-million expansion of Transcontinental Gas Pipe Line Corp. has been approved by an FPC examiner. The new facilities would add 132.8 million cubic feet of daily capacity to Transco's system. They were approved with this condition: That Transco allocate the additional gas to customers according to FPC plans. The expansion will enable Transco to service the eastern shore of Delaware and Maryland through Eastern Shore Natural Gas Co., which will build 124 miles of line at a cost of $3 million.

Transco's building plans go like this: North of its No. 5 station in Evangeline Parish, Louisiana, 112.6 miles of 36 and 30-in. main-line loops; 12.8 miles of 24-in. lateral loops; 32,500 compressor horsepower in three new stations; and 4,000 hp. added at another station. South of the station, 15.8 miles of 30-in. main-line loops; 247 miles of 24 to 3-in. purchase laterals; 18,640 additional horsepower; and eight new dehydration plants.

Two more companies have been exempted from FPC regulation under terms of the Hinshaw amendment to the Natural Gas Act. The two firms are Hoosier Gas Corp. and Hoosier Pipe Line Corp., both operating within the State of Indiana.

The Hinshaw amendment exempts companies from federal regulation if all the gas purchased within a state is consumed within the same state, and if the rates and facilities are regulated by a state commission. Since the amendment went into effect in 1954, a total of 109 companies have been exempted.

Muskegon Pipe Line Corp. has completed one-third of its 10-in., 165-mile crude line from Griffith, Ind., to Muskegon, Mich. Progressing at the rate of 2 to 4 miles daily with two spreads, the line is scheduled for completion late in November.

About 60 miles of the northern spread and 12 miles of the southern spread is already underground. The line will carry 26,000 bbl. of crude daily to Michigan refineries from Service Pipe Line Co.'s system at Griffith. Midwestern Constructors, Inc., Tulsa, has the contract, and Service is construction and operating agent for Muskegon.

Collins Construction Co. has been awarded a contract to construct a dual 10-in. pipeline crossing on the Detroit River for Canadian Brine, Ltd. Work is scheduled to begin at once. The submarine lines will transport brine from the Canadian company's plant at Windsor to the Solvay Process plant in Detroit. Collins has named Fred O. Wakefield general superintendent of the project.

Also for Pipeliners . . .

IN THE NEWS: Look for more pipelines transporting solids in slurry, A.S.M.E. delegates told. Gilsonite and coal lines may set a trend. Also outlook for plastic pipe is still good (p. 51) . . . Shortage of engineers still persists in oil industry. Starting pay will continue to rise (p. 52) . . . New double-jointing unit cuts costs and speeds pipe laying (p. 60).

PLUS THESE TECHNICAL REPORTS: How to eliminate errors in testing pipeline-flow efficiency (p. 88) . . . and Pipeline Patrol's construction report (p. 121).

Big Offshore Discoveries Seen

NEW ORLEANS.—With proper economic incentives, offshore operators should find as much as 6 billion barrels of oil and 40 trillion cubic feet of gas in the next 10 years.

This optimistic forecast was made last week by Bouwe Dykstra, vice president of Shell Oil Co.

Addressing the Louisiana-Arkansas division of the Mid-Continent Oil and Gas Association, Dykstra pointed out that the offshore industry would have to be six or seven times as successful in the next 10 years as it was in the past 10 if the discovery goal is reached.

"It seems a tremendous assignment," he said. "Yet I believe under the proper economic incentives it can be done."

Gulf is target . . . Dykstra said that oil reserves totaling 3 to 3½ billion barrels a year must be found by the nation as a whole during the next decade. A large portion of these reserves should be found in Louisiana and in the deeper waters of the Gulf of Mexico.

It is estimated that at the beginning of the year approximately $2 billion had been invested offshore.

"It is my estimate that at the present level of operation, the difference between outflow and income of capital is on the order of $1 million per day," Dykstra said.

"It would be unfortunate," he added, "if this daily additional investment in offshore operations on top of the already invested capital should cause a slowdown of those offshore activities."

Tax incentive needed . . . Discussing the economic incentives of offshore operations, the Shell executive warned that any change in the depletion allowance could be a mortal blow. Because of transportation costs offshore crude now has a disadvantage of about 50 cents a barrel, he said.

Dykstra urged a new production allowable formula giving a greater bonus to wells in deep water.

"In my opinion, wells in more than 20 ft. of water should have a 'deep-water allowable,' higher than the offshore allowable, and, again, wells in more than 45 ft. of water should be given a 'blue-water allowable' higher than the allowable of a deep-water well," he said.

In total volume, this would not mean a great increase in the allowable, he said, but it would furnish the needed stimulus for offshore development.

Dykstra pointed out that "not only are we producing our onshore oil in South Louisiana at a lower ratio to known reserves than the national average, but the ratio of offshore production is about one-half the national average."

Operations start this week as . . .

. . . Rangely Becomes a Unit

DENVER.—A stepped-up program of secondary recovery and conservation gets under way this week in Rangely oil field in northwestern Colorado.

Unitization of the field, largest in the Rocky Mountain region, was approved August 20 by the Colorado Oil and Gas Conservation Commission and September 19 by the U. S. Geological Survey in Washington. The unit agreement becomes effective October 1.

Approval of the federal agency was necessary because about 9,000 acres, or some 42 per cent of the 19,135 acres in the unit are public domain. The unit is the second largest in the nation in terms of reserves. Only SACROC in West Texas is larger.

USGS now takes over administration of the field from the Colorado Oil and Gas Commission.

One of the state agency's last official acts before turning over supervision of the field was to revoke a commission order issued in July 1956 limiting Rangely oil production to 300 bbl. per day from any well and requiring injection of accompanying gas exceeding 180,000 cu. ft. per well to the Weber (Pennsylvanian) sand area.

The commission also approved a general plan for operation of the Rio Blanco County field.

The California Co., unit operator by virtue of its major interest in Rangely, plans to expand existing conservation practices immediately by putting down two gas and two water-injection wells in the field's periphery.

Calco also is relocating certain equipment, such as consolidating compressors and batteries. Eventually the whole field will be flooded.

The pilot water flood will determine the number and location of water-injection wells, how much gas will be injected, and other engineering details. The field is currently injecting about 95 million cubic feet of gas. The field-wide flood will be peripheral, encroachment type. The number of wells to be shut in has not been decided.

The field now has 441 producing wells, 19 gas injection wells, and 21 wells shut in or abandoned.

Total oil in place in the Weber formation is estimated at about 1½ billion barrels. Recoverable oil by primary means had been estimated at 350 million barrels. Use of gas injection and water flooding is expected to produce an additional 385 to 437 million barrels of oil.

Big-Field Rule Due

Long fight over joining 81 fields is nearing its end

AUSTIN.—Texans may learn this week whether 81 Bend conglomerate gas fields in Jack and Wise counties will be consolidated into one giant reservoir.

Reply briefs have been filed, and the Texas Railroad Commission may rule on the issue September 30.

Favoring the consolidation are Lone Star Gas Co., its affiliate, Lone Star Producing Co., and Brazos River Gas Co. Opposing it are the Christie, Mitchell & Mitchell group of Houston and Warren Petroleum Corp.

If the former group wins, a huge new gas field stretching 35 to 40 miles long and 20 to 25 miles wide and taking in more than 550,000 acres and 362 wells will be formed.

Hearings were held last May (OGJ, May 27, p. 96), and first briefs were filled early in August.

The recently filed reply briefs follow lines of argument previously advanced.

Lone Star says that differences in field rules, governing such things as spacing and allocation formulas, are causing nonratable take, inequities, and general confusion. And further that such conditions will be magnified and become ridiculous and chaotic as field development proceeds.

Christie, Mitchell & Mitchell and Warren contend there is no evidence that the bend stringers are connected throughout the big area. Development is too sparse to warrant such wholesale consolidation, they argue. The producers contend that none is being hurt by drainage now, but that inequities and nonratable take would certainly develop if "separate reservoirs should arbitrarily be declared one."

A Dowell engineer will tell you the advantages of Allison aircraft-powered pumpers.

Make fracturing treatments more effective ....with DOWELL auxiliary services

Fracturing treatments to improve oil or gas production often call for more than just sand and a carrying fluid. Special addition agents and auxiliary services can mean the difference between success or failure.

Dowell engineers have at their disposal a wide variety of fracturing aids to solve specific well problems. Here are four of the more important Dowell products and services that help you get even better results from fracturing.

MUD ACID is a mixture of hydrochloric acid and hydrofluoric acids. It dissolves clay minerals and destroys the swelling and colloidal properties of bentonitic materials. As a spearhead, Mud Acid increases fracturing effectiveness by cleaning the formation face.

F. L. A.* (Fluid Loss Additive) is designed to lower the fluid loss of fracturing fluids. F. L. A. helps provide longer fractures and deeper penetration of sand. There are several kinds of F. L. A. to meet various well conditions.

FIXAFRAC* uses a temporary plugging material consisting of solids suspended in a fluid. These solids liquify after a short time and return to the well bore. Fixafrac is used between treatment stages to seal initial fractures or permeability, allowing new fractures to be formed in other sections of the pay zone.

FREFLO* is a mixture of chemicals that acts in three ways to prevent or destroy water block. It reduces surface tension, it partially destroys interfacial tension between water and oil, and it breaks emulsions. In fracturing treatments, Freflo is added to the breakdown and flush oil to prevent emulsions.

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Erie Test Awaits Spring

● First offshore drilling on U.S. side of Great Lakes touched off by Pennsylvania lease sale. New York firm pays rental of $90,906 for Lake Erie blocks

HARRISBURG, Pa.—First offshore drilling on the U. S. side of the Great Lakes is likely to begin next spring.

New York State Natural Gas Corp., high bidder last week on two blocks of Pennsylvania land in Lake Erie, says it cannot begin operations until after the winter freeze and spring thaw.

This gives the company about 6 months to decide on where and how to drill if the state accepts the bids. The secretary of the Pennsylvania Forests and Waters Department was scheduled to act soon.

Despite a great deal of interest, only two companies submitted bids on the two blocks which the state offered. The other firm was Kewanee Oil Co., of Philadelphia and Tulsa.

New York State bid $3.79 per acre annual rental for 19,130 acres in Block 1. This was much higher than Kewanee's bid of 33 cents per acre for the same block.

New York's bid for Block 2 was $1.11 per acre annual rental for 16,580 acres. Kewanee's bid for the same tract was 43 cents per acre.

If the bids are awarded, and production is found, Pennsylvania will get the customary ⅛ royalty.

State disappointed . . . Robert C. Barwick, chief of the department's minerals division, said he was disappointed in the small number of bidders. He said that only 1½ months intervened between publication of the offer and the bid opening. This, he said, did not allow companies enough time to study Lake Erie's possibilities.

Major companies did not submit bids, although the majors were well represented at the bid opening. Barwick said he felt more bidders will take part when the state makes further offerings.

He didn't say when or how future offerings would be made, but he made it clear that there would be more. If production is found on Blocks 1 and 2, additional blocks may be offered on a different basis.

Drilling plans . . . F. C. Hauber, executive assistant to the president of New York Natural, said that freezing of the lake will prevent operations this year.

By next spring, the company will have had time to decide on what type of equipment to use and where to drill the first test.

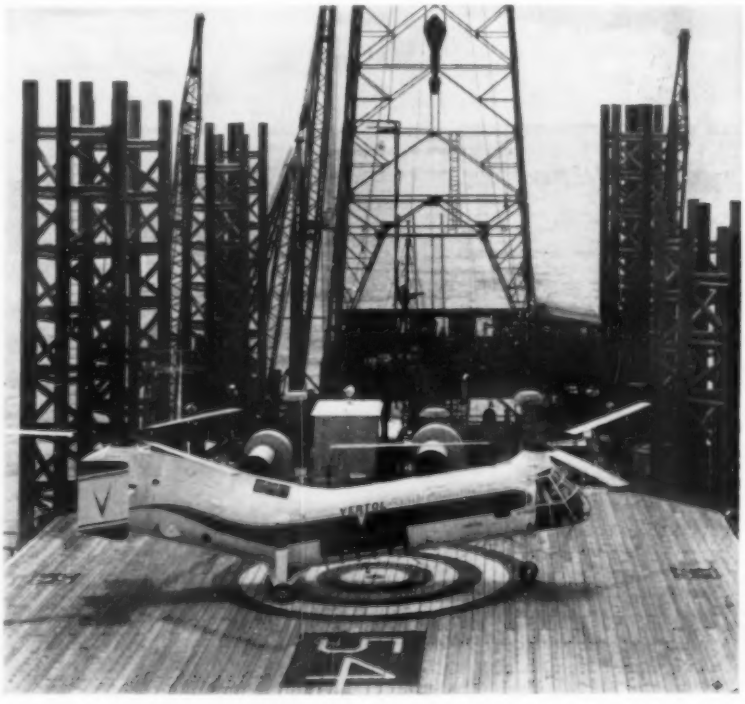
He said both blocks are in 30 to 50 ft. of water and are all at least ½ mile offshore. Pennsylvania law will not permit drilling any closer to shore.

The Red Medina is regarded as the most likely producing formation, although there are possibilities for Oriskany production also. The Oriskany is the major gas-producing formation in the New York-Pennsylvania-West Virginia area.

Gas has been found in the Red Medina in Ohio, and oil is produced from this sand in the vicinity of Niagara Falls. Because of this, there is strong belief that either gas or oil, or both, will be found under the lake.

A successful Red Medina well is said to have been completed recently on the shores of Lake Erie about 5 miles from Block 1.

New York State Natural is the biggest operator in Pennsylvania. In addition to producing properties, the company has extensive distribution facilities.



Oil Gets a New Airlift Tool

HOUSTON. — The world's largest commercial helicopter showed off for oil men here recently and made quite an impression.

Working with equipment especially designed for airlifting, the big flying machine picked up a 4,115-lb. piece of oil-field machinery, then brought it back down and deftly set it in a wooden rack. Just for good measure, it also lifted a Craig Helicop-Hut, a complete oil-field office weighing 950 lb., also designed for airlifting operations.

The helicopter is the Vertol 44, capable of carrying 19 passengers or more than 2 tons of cargo. The Vertol company says it will shuttle an entire drilling rig 50 miles in 56 hours of flying time.

The rig is built by National Supply Co. and patterned after the National 50 draw works. It is designed to require a minimum of knock-down and assembly.

The Vertol 44 cruises at about 100 miles an hour and has a top speed at sea level of close to 130 miles an hour. Its payload is 5,345 lb. and service ceiling 10,600 ft. It ranges

more than 360 miles, with a reserve supply of gasoline left for emergencies.

Manufacturers claim the new helicopter has greater stability and can be loaded and unloaded more quickly than its predecessors. That, they say, is because of a wider range of center of gravity, making it possible to shift loads without upsetting weight and balance.

Navy Plans Sunk

Oil firms fight proposed Louisiana gunnery range

BATON ROUGE.—The U. S. Navy has withdrawn its proposal to establish a Naval gunnery range in an area along the Louisiana coast which embraces eight oil and gas fields.

The Navy's request for exclusive "air space" rights in an area covering about 1,000 sq. miles had been scheduled for hearing by a subcommittee of the Civil Aeronautics Administration in Atlanta October 2.

Proposed site for the gunnery range is about 25 miles wide and 40 miles long. Approximately half of the area lies offshore, extending beyond Block 21 off Vermilion Parish. Most of the land area sought by the Navy is in Vermilion Parish, with one corner extending into Cameron Parish.

Oil companies joined with state agencies in protesting the Navy's proposal.

The surprise plan was disclosed by Gen. T. B. Herndon, chief of the Aeronautics Division of the Louisiana State Department of Public Works. It later was withdrawn in the face of mounting opposition from landowners, state agencies, and oil interests.

Attorney Gen. Jack P. F. Gremillion warned that the Navy plan would require evacuation of at least seven villages in the coastal area.

Gasoline Plant Planned

TULSA.—Warren Petroleum Corp. and Sunray Mid-Continent Oil Co. plan to build a natural-gasoline plant near Mocane pool in Beaver County, northwestern Oklahoma.

The plant will be the refrigeration-absorption type and will process about 100,000 M.c.f. of natural gas daily. Liquid output will be an estimated 100,000 gal. daily. Warren will operate the plant and will take gas from Colorado Interstate Gas Co.'s pipeline system.

The plant will cost about $3,000,000. It will be located about a mile or two west of the town of Mocane. However, Warren says it will probably be a year before the plant is built.

Processing briefs

Standard Oil Co. (Ind.) is operating its new alkylation unit at the 75,000-bbl. refinery at Sugar Creek, Mo. Capacity of the new unit is about 3,800 bbl. daily. The principal fractionating tower is 150 ft. tall and contains 56 specially designed trays. This makes seven new processing units that Standard of Indiana has put into operation at six midwestern refineries this year.

A new natural-gasoline plant is being built 4 miles south of Fort Morgan, Colo., near Adena field by J. M. Loffland Co., Fort Worth, Tex., and B. F. Allison Drilling Co., Fort Morgan. The plant reportedly will process about 2,000 M.c.f. of gas daily, and will operate under the name of Loffland & Allison Gas Co. Green Brothers of Fort Morgan is contractor.

Monsanto Chemical Co. will more than double its high-impact styrene-polymer production capacity at the Springfield, Mass., plant. The new facility, scheduled for completion next May, is part of Monsanto's big expansion program to meet the growing demand for styrene plastics.

In July, the firm's plastics division announced plans to increase styrene-monomer production capacity by 40,000,000 lb. at the Texas City plant. Completion is scheduled in June. Last spring, the company completed a multimillion-dollar addition to the Texas City ethylene production facilities.

Commercial Solvents Corp. has purchased a 10 per cent interest in Northwest Nitro-Chemicals, Ltd., from New British Dominion Oil Co. Commercial Solvents operates the Northwest ammonia plant at Medicine Hat, Alta.

After 56 years of operation, one of California's oldest refineries is going out of business. Union Oil Co. is shutting down its 8,800-bbl. plant at Bakersfield and converting it to a distribution terminal. The shutdown started this month and will be completed about October 1. The plant was built in 1901.

The largest heaters ever designed for Platforming units are going in at Gulf Oil Corp.'s 26,000-bbl. refinery at Philadelphia. They are 100 ft. long. Each will handle two intermediate stages. Procon, Inc., which is installing them, recommended the single heaters for each Platformer to conserve space and for maximum construction and piping economy. The units should be on stream by early next year.

Canada's first chemically pure benzene, toluene, and xylene from petroleum is being turned out at the Sarnia refinery of Canadian Oil Companies, Ltd., by an integrated U.O.P. Platforming-Udex extraction unit. The recently completed unit finishes up a $3-million expansion.

The Platformer, with a design capacity of 4,400 bbl. daily, is producing charge stock exclusively for the Udex facility. Another Platformer is producing a high-octane blending component for gasoline. Neighboring chemical plants have contracted for the total benzene output. The other aromatics are being used in motor fuels.

Fluor Corp., Ltd., of Los Angeles has established a wholly owned subsidiary in London. The new firm is Fluor Engineering & Construction Co., Ltd. It is headed by James Tathwell, former manager of projects at Los Angeles.

Also for Refiners . . .

IN THE NEWS: Higher operating severities and more plant investment are in the book for refiners (p. 49) . . . Two new refineries are planned for East Coast of U.S. and Canada (p. 49) . . . Gas turbines may find greater use in refineries, A.S.M.E. delegates told (p. 51) . . . Shortage of engineers still persists in oil industry and there's no end in sight (p. 52) . . . Refiners await decision on quota adjustments as key to how tough Government will be in enforcing voluntary imports-control program (p. 56) . . . A Northwest refiner has contract to take crude from Sunshine Mining Co.'s new Washington producer (p. 57) . . . Heavier crudes making comeback on California market (p. 58) . . . Premium octane ratings have bounced back to record high of 98.2 numbers (p. 60) . . . Demand for Alberta crude is lowest in 28 months (p. 63) . . . Tidewater reported planning new refinery in West Germany (p. 74).

PLUS THESE TECHNICAL REPORTS: Reports on ethylene oxide by the direct oxidation process (p. 80) . . . On the Job. . . In the Plants (p. 103) . . . How the H-Oil process converts refinery residuals (p. 109) . . . Questions on Technology (p. 115) . . . and Refinery construction report (p. 116).

THIS CRUSHER simplifies salvage of aluminum cans. Device squeezes cans into coin-shaped slug, at left in front of full can. Slugs are thrown in oil drum.

Esso Sells Oil in Aluminum Can

ALUMINUM CANS—rustproof and lightweight—will be used as containers for motor oil on a big scale for the first time this year.

Esso Standard Oil Co. has contracted with Reynolds Metals Co. for the aluminum sheet that will be used in 35 million quart cans at Esso's Bayonne' N. J., packaging plant.

The new can will not rust and weighs about half as much as one made of tin-plated steel.

To make the higher-priced aluminum competitive, Esso has worked out a salvage plan for service station dealers. The can is placed in a compressed-air device that crushes it into a compact slug. The slug then is tossed into an oil drum "bank" for sale as salvage by the dealer (see photo).

Before adopting the aluminum can idea on a big scale, Esso market-tested it in Norfolk and Richmond with 200,000 qt. of motor oil.

The aluminum cans are made by American Can Co. and Crown Cork & Seal Co. About 51 tons of aluminum are used to make 1 million cans.

Esso may expand the aluminum operation to its Baltimore plant, where 30 million quarts are canned yearly.

Esso's present contract for aluminum cans runs from 3 to 4 million dollars. The new cans will be introduced in New England, New York, New Jersey, and part of Pennsylvania before the year's end.

Oklahoma's Deep Test Halted

OKLAHOMA'S PROSPECTS for boasting the world's deepest hole disappeared last week.

Magnolia Petroleum Co., as operator for itself and its several partners, has decided against carrying the record-breaking 1 Sterba-Ordovician any deeper.

Plans are to plug back up the hole from its present 20,446-ft. total depth and attempt completion in the Springer formation. Good gas shows were recorded from that zone at about 14,510-40 ft.

At 20,446 ft., the deep geological wildcat on the big Cement field structure in Caddo County is the deepest hole in the state by 2,288 ft. The previous record holder was Frankfort Oil Co.'s 1 Pruitt, completed dry at 18,158 ft. in Grady County last year.

Decision unexpected . . . The Magnolia decision to plug back came as a surprise to some. The company had queried the contractor as to rig capacity and sought the views of partners on going for the Simpson formation, expected at about 24,000 ft. Also statements of operating personnel had left little doubt the company would drill to the record depth.

But Magnolia never stated officially it would continue the expensive operation to the Simpson.

Company spokesmen declined last week to say why drilling was halted other than to explain it was a "management decision."

Informed sources say the management felt trying to extend the already lengthy stretch of open hole in the Sterba another 2,500 ft. or more was too risky and expensive when weighed against what the well might find if, and when, it got there.

Too, these sources said Magnolia's share of the cost load the rest of the way would have been higher than its initial 50 per cent.

Some drop out . . . The firm's partners in the venture at the outset were Phillips Petroleum Co., Gulf Oil Corp., Pan American Petroleum Corp., Phillips Chemical Co., Sunray Mid-Continent Oil Co., and Anderson-Prichard Oil Corp.

Anderson-Prichard is reported to have dropped out when the well reached 18,000 ft. and Sunray Mid-Continent at 20,000 ft. This reportedly left about a 13 per cent interest which someone had to absorb. Magnolia, these sources said, was unwilling to increase its already large share of the venture and failed in its efforts to persuade its partners to take up the slack.

The 1 Sterba was running logs last week preparatory to plugging back. At total depth, it was still in the Sycamore lime, which it topped at 19,959 ft.

Magnolia officials said last week that the hole definitely is as deep as it will go for now but pointed out it would be simple to reenter and deepen if desirable.

Ohio Test Flows Big

CONNEAUT, Ohio.—A major pool may have been opened 10 miles south of this extreme northeastern Ohio town by M. L. (Mike) Benedum. The well is about 50 miles from Titusville, Pa., where the nation's first oil well was drilled.

The 1 Scribner, drilled by Benedum-Trees Oil Co. and two affiliates, reportedly flowed 30, 38, and 70 bbl. of oil respectively in three 15-minute tests. Seven-inch casing was cemented through a reported 100 ft. of saturated Medina and the hole was fractured through perforations. The well was shut in when available storage was filled. Production tests were scheduled for this week.

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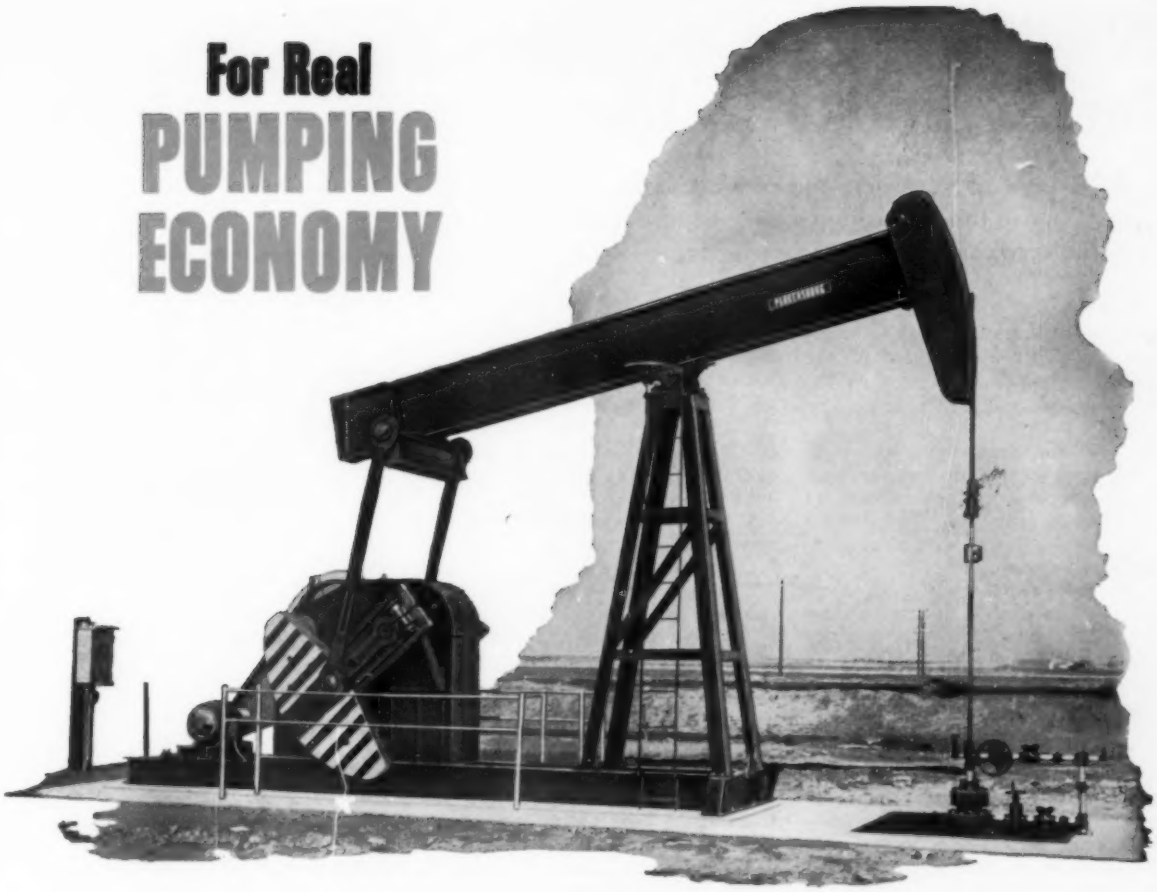

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P·E·S·A

Jersey Looks to Iran

● Bid on offshore acreage coming soon, but it won't be on a share-the-operations basis; company thinks the old reliable, a big cash bonus, will do the trick

STANDARD OIL CO. (N.J.) is ready to play for cash against chips that could prove worthless in the game for new oil concessions in the Persian Gulf.

Jersey is betting that the lure of a big cash bonus—a sure thing—will prove stronger to Iran than an interest in new oil operations—always an uncertain bet. That's the way Howard Page, Jersey director, paints his company's position.

The cash bonus, described by Page only as "substantial," is Jersey's answer to the much-discussed, so-called 75-25 profit split the Italians have offered Iran. He calls the 75-25 deal nothing but a gimmick to avoid paying a bonus for a concession.

Home in New York last week after a trip to Teheran where he laid the groundwork for a Jersey concession application, Page said his company is shooting for offshore acreage.

He thinks Iran's underwater prospects are probably just as good as those on land. Offshore acreage is easily accessible to tankers for moving any oil found. And pipelines are no problem.

Jersey Standard expects to make its offer soon. Page believes the Iranians will throw open the entire offshore Persian Gulf bordering Iran by the end of this month. He expects Iran to push for an agreement between Persian Gulf countries to define offshore boundaries to avoid any ownership dispute.

How he sees a bonus . . . Page calls the bonus approach a "bird-in-hand" offer. He thinks it is more attractive to a country offering oil concessions. He obviously thinks the Iranians will weigh what he has offered and agree with him.

"When I say 'substantial' I don't mean a million dollars," the Jersey director says with a grin. He hastens to add that he isn't thinking in terms of the $36-million bonuses that Lake Maracaibo acreage brought this year in Venezuela, either.

"You have to consider that Venezuelan oil brings about 75 cents a barrel more than Middle East oil when you talk bonuses."

There has been much published speculation that the joint participation deal made by the Italians in Iran may break down the time-honored 50-50 profit split between company and government. Page disagrees emphatically. He doesn't think the Italian-Iranian deal is going to have any effect on existing Middle East agreements.

It may, he concedes, have a bearing on future oil concessions the world over.

The half interest in an operating company which the Italians gave Iran in exchange for three new concessions could affect the future. But it isn't certain to do so.

"Every country that offers new concessions in the future is going to take a look at this kind of a proposition," Page says. "And they should. Each country is going to have to determine for itself the best possible deal it can make."

He points out that it might be in the country's best intrests to take on a joint operation in areas that are not regarded highly enough to attract a bonus.

"That kind of a deal is better than no deal at all," he comments.

The joint-operation type of deal might also be made if the partner offering to explore doesn't have the money for a bonus.

Jersey has the money. It would rather pay a bonus and conduct its own exploration without any partners.

Bonus advantages . . . Page points out that Iran may make a profit on its deal with AGIP Mineraria, the Italian Government company, but it might not. If the Italians don't find any oil, Iran hasn't gained anything or lost anything either.

Regardless of whether Jersey finds any oil offshore in the Persian Gulf, Iran will pocket the bonus the company is willing to pay for the privilege of looking.

"People who claim there has been a breakdown in the 50-50 formula as a result of the Italian deal are overlooking the bonus entirely," Page says.

He points out that Iran will get no oil revenue from its Italian deal during the 12-year exploration period unless a discovery is made. If a bonus had been paid, and the money invested or simply banked, it would draw interest for that entire 12-year period.

If the Italian-Iranian company makes only a small discovery, Iran faces the prospect of only a small profit from the proceeds of the production. In this case, Page believes the Italians themselves could handle the marketing end of the deal.

But, if the joint company makes a big discovery and finds a large volume of oil it will be faced with an outlet problem. The oil itself is not enough. It must have markets.

Page says Jersey can offer Iran a sure thing in its bonus. If the operation is successful, Jersey can also provide the markets for the oil in large volumes.

Libyan Test in '58

Ohio will drill the first for affiliates of Conorada

THE FIRST WELL to test the 47 million acres under concession in Libya held by three American oil companies will be drilled early next year about 75 miles from the Mediterranean Coast in Tripolitania.

Oasis Oil Co. of Libya, wholly owned subsidiary of Ohio Oil Co. has let the drilling contract to International Drilling Co. N.V.

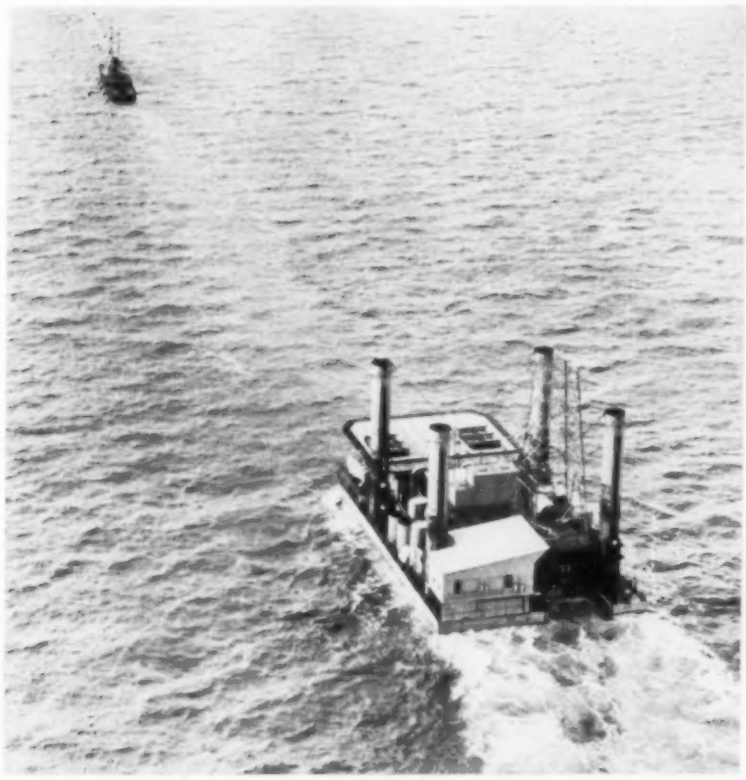
Oasis has done extensive geological and geophysical work on areas held by its parent and on concessions owned by Continental Oil Co. and Amerada Petroleum.

The three companies in the Conorada group applied individually for the acreage, but each shares a one-third interest in that held by the others. Oasis will act as operator for all three.

The first block to be drilled is a 1,270,000-acre concession in the name of Oasis. It is about 75 miles south of the Gulf of Sirte in North-Central Libya. The north-south elongated block is surrounded by acreage held by Mobil Oil of Canada, Libyan American Oil Co. (Texas Gulf Producing), and Cie. Francaise de Petrole.

Fred J. Funk, manager of Ohio's foreign oil operations, says the wildcat will test a north-south anticline, a prominent geological feature of the concession. The well may go to 15,000 ft.

International Drilling is now assembling a new heavy duty rig on the Gulf Coast for Libya.



Mobile Barge Is Long Way From Home

THERE'S still a long tow to go for Europe's first mobile drilling barge as it lumbers through the English Channel on the first leg of its trip to the Persian Gulf.

Before the trip ends, the barge will have covered a distance of 6,800 miles, one of the longest tows on record. It is expected to average about 4 knots on the trip and be ready to spud its first test some time early next year (OGJ, Sept. 2, p. 103).

The barge, "Adma Enterprise," is the first of its kind to be used anywhere outside the U. S. It is a De-Long version built at the Kiel Canal shipyard in Germany. Its first job will be in about 50 ft. of water some 20 miles off the little island of Das.

It will drill for Abu Dhabi Marine Areas, Ltd., which holds a concession on 12,000 sq. miles of underwater lands off the Trucial Coast of Arabia. The company is jointly owned by British Petroleum Co., Ltd., and Cie. Francaise de Petroles.

Central Maracaibo Is Tested

THREE KEY WILDCATS in central Lake Maracaibo are now drilling and location for a fourth has been staked.

The drilling that has been done since Venezuela first granted its first new lake concessions last year has moved the prolific Eocene production farther into the lake's center (OGJ, Sept. 2, p. 83).

The three wells that are now under way can either extend that productive region farther southwest or give some indication of its limits.

Here are the wells to watch:

. . . In Block 17, the tract farthest southwest of any yet granted in the lake. Phillips Petroleum Co. last week spudded LPG-1-1. This test in the northwest corner of the 24,700-acre lake block is farther west than any yet drilled in the lake. The platform is in 100 ft. of water. This test is projected to 13,500 ft., or into the upper Upper Cretaceous.

Phillips is the operator and principal owner in an eight-company group which owns the concessions. Kermac Drilling Co., a subsidiary of Kerr-McGee Oil Industries, Inc., another of the owners, is doing the drilling. The owners of the block in addition to Phillips and Kerr-McGee include Sunray Mid-Continent Oil Co., Ashland Oil & Refining Co., Western Natural Gas Co., El Paso Natural Gas Co., Pacific Petroleums, Ltd., and Canadian Atlantic Oil Co., Ltd.

. . . In Block 7, Cie. Shell de Venezuela is drilling two deep tests. Both are farther south than any yet drilled in the central lake region. If either should encounter the prolific Eocene production which is found to the north and east, it would give the entire central lake region a shot in the arm.

Shell's first test is VLE 196-X. This well was nearing 12,000 ft. last week. It is located in the northwest section of the 24,700-acre lake block.

The second, VLE 198-X, is about 12 miles to the east and south of the first Shell well. Last week this test was below 7,000 ft.

. . . In the much disputed Block 10, directly east of Shell's Block 7, Phillips has staked the location for the first test of this tract. A new barge was outfitted in Orange, Tex., for the operator and is en route to Maracaibo. The test is expected to be spudded between October 10 and October 15. Delta Gulf Drilling Co. will handle the drilling.

Title to this block was granted to San Jacinto Petroleum by the Venezuelan Government, but Phillips now holds 45 per cent interest.

Signal's well . . . Meanwhile, farther to the north in Block 4, Signal Exploration Co. issued a progress report on an exploratory well of a four-company combine.

Signal, the operator, said its Centro 2X is drilling below 12,550 ft. Well logs and ditch samplings give evidence of substantial oil staining and fluorescence in six intervals of C zone Eocene sands totaling some 200 ft. There has been no commercial testing. Oil indications also were found higher in the section.

Refinery Switches to Gas

THE NEW 177-mile, 20-in. pipeline of Cia. Shell de Venezuela is now feeding natural gas from La Paz field directly into the boilers of Cardon refinery.

The line originates in the producing area west of Lake Maracaibo, which it crosses at the lake's neck, and runs north of, and parallel to the company's Lightline. Its capacity is 106,000,000 cu. ft. daily with one pumping station.

Shell switched to gas as refinery fuel at the 145,000-bbl. plant to utilize the gas and to make more fuel oil available for export. Williams Bros. of Tulsa handled the project.

Loffland Bros. drilling tender sails south, where . . .

Paria Test Soon Will Start

THE FIRST of four platforms in the Gulf of Paria is being erected in the Block 13 concession held by five American companies. And a drilling tender is expected to arrive early this week in preparation for spudding by October 15.

Company representatives will meet in New York this week to select an operator for the drilling program in the costly untested concession.

The first platform, where the initial well probably will be be drilled, is located on Parcel 112 of Block 13, adjacent to the international boundary. The site is some 10 or 11 miles from offshore Trinidad production in Soldado field.

Four drilling permits have been issued in the five-company concession area, and the platforms will be spotted at the approved sites.

Holders of the concession, which covers Blocks 9-14 and nearly 150,000 acres, are The Texas Co., Continental Oil Co., and Ohio Oil Co., each of which own 25 per cent; Cities Service Oil Co., 16⅔ per cent; and Richfield Oil Corp., 8⅓ per cent.

The drilling tender is owned by Loffland Brothers Co., Tulsa, which has the drilling contract for the four locations. Built by Levingston Shipbuilding Co., it is named for Orville Fisher, southern regional vice president for Continental.

The valuable concession area in the Gulf of Paria cost the five-company combine $100 million, and the Block 13 well will be the first test in the Venezuelan section of the gulf.

Operating headquarters will be located mostly on the tender for the time being.

Brown & Root Marine Operators, Inc., fabricated the four platforms, and one is being driven into place this week at the Block 13 location.

Petrochems to Mushroom

THE OUTPUT of the West European petrochemical industry will more than double within the next 5 years, with polyethylene taking the lead.

Dr. Colin Haley of Esso Research, Ltd., Abingdon, England, made the prediction in a speech at the thirtieth International Congress of Industrial Chemistry at Athens. The current output of West European petrochemicals of all kinds is about 600,000 tons a year. The British research expert says this will be 1,000,000 tons by 1959 and 1.5 million tons by the next 5 years.

Dr. Haley says the big expansion for polyethylene will come in its use for water piping and plastic bottles. He pointed to the new synthetic-rubber projects now under way in France, Germany, Italy, and Britain to support his prediction.

He estimated that synthetic detergents in Europe will follow the lead they have established in the United States where they account for two-thirds of all washing materials.

Crash Kills Nine

Venezuelan accident takes lives of Socony officials

FIVE OFFICIALS of Socony Mobil Oil Co. in Venezuela were killed early this month when the DC-3 airliner on which they were passengers crashed into a mountain.

The plane, an Avensa airliner, disappeared September 3 on a flight from Maiquetia to Barinas where Socony has a producing field. The wreckage was not discovered for more than 2 weeks in spite of an intensive air search.

Ground parties who reached the wreckage in Trujillo's rugged mountain country said the plane apparently crashed into a peak known as Pena Blanca and then plunged into the bottom of a ravine.

In addition to the Socony personnel aboard, the plane carried a pilot, copilot, stewardess, and a purser. All were killed.

The Socony victims were:

. . . **Roy Jackson Tribbey,** 36, general superintendent of field operations for Socony. A native of Vanderbilt, Tex., Tribbey had been in Venezuela with Socony 14 years.

. . . **Horace Lynn Benson, Jr.,** 48, Socony's eastern division accounting supervisor at Anaco. A native of Los Angeles, Benson had been in Venezuela for 9 years.

. . . **Arthur L. Clark,** 44, personnel coordinator in Socony's Caracas offices. Clark had been in Venezuela only a year after spending 22 years with the company in Buffalo, N. Y.

. . . **John Francis Martin,** 35, chief general engineer for Socony at Caracas. Martin spent 8 years in Venezuela and had previously worked for Magnolia Petroleum Co. in Texas. His home was Cleveland, Ohio.

. . . **Benjamin Oliver Ormond,** 48, industrial services supervisor, at Anaco. He was a native of Forest, Miss.

TWO MIGHTY MIDGETS

in Bethlehem's Line of Pumping Units

Details of 25DA crank and counterweights

Model 25DA-6S-28

Model 6D-B3-16

It isn't always the giants that win the interest of the crowd. Often the midgets get into the spotlight too.

That's going on right now in several producing areas. Two little Bethlehem pumping units are stirring up interest wherever they're installed. The larger is known as the 25DA. The smaller, not even as tall as a man, is the tiny 6D. Here are some features of each:

The 25DA has four adjustable rotary counterweight shells with built-in clamping devices. Positive locking pieces provide an extra factor of safety. When weight adjustment is needed, these pieces can easily be removed, and a wrench-mounted counterweight pinion inserted. Force applied to the handle of the wrench causes movement of the counterweights in either direction.

Four auxiliary filler weights are available to fit the shells if extra counterbalance is necessary. This gives a maximum counterbalance effect of 4430 lb with 28-in. stroke. The unit is furnished with subbase and with extended base beams that accommodate a variety of prime movers.

The 6D, smallest Bethlehem pumper ever built, is intended primarily for stripper and water-well service. This midget has the familiar Bethlehem double-reduction gear reducer with a capacity of 6000 in.-lb torque. Its structure is simple in every detail, yet rugged throughout. Lubrication, maintenance, and all adjustments are easily accomplished.

A.P.I. sizes go no smaller than Bethlehem's 6D. We'd like to tell you more about these husky little units. They can be the means of effecting substantial economies. For full details, call the Bethlehem Supply office nearest you.

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Refining Goes Modern in Red China

A REFINERY under construction in north-central China is a far cry from the usual bailing-wire-and-pipe type of plant that has been representative of the Communist Chinese oil industry. The refinery, according to the Eastfoto agency in this country, is being built at Lanchow, the focal point of China's north and northwestern oil industry.

The new plant is in the general vicinity of the old Yumen field in northwest China which the Chinese expect to produce an average of more than 15,000 bbl. daily in 1957. Lanchow is now being linked by railroad with the newer fields in extreme northwest China in the Dzungarian basin.

According to the Chinese Communists the plant will produce gasoline, kerosine, and diesel fuel primarily. No throughput figures have been revealed, but the Reds boast the new plant contains 414 miles of underground piping.

Tidewater May Enter Germany

REPORTS COMING from West Germany indicate that Tidewater Oil Co. interests are planning to build a refinery and petrochemical plant near Dinslaken on the lower Rhine River north of Dusseldorf.

This region of West Germany has prospects of becoming a new major refining area, to be served by two proposed pipelines. One line is planned from Wilhelmshaven on the North Sea coast to Cologne and the second is a major trans-European trunk line from Marseilles on the Mediterranean to Rotterdam.

Tidewater neither confirmed nor denied reports of the new venture. It said that for a number of years it has had investments and operations in the free world, including West Germany, and that it continually reviews prospects for new projects abroad.

The report, says Tidewater, apparently refers to one of a number of places the company is looking at, but there is nothing to report now.

Old Well Acts Up

Gas injection in old field in Germany causes blowout

WEST GERMANY, a steady but not very spectacular oil producer, has just gone through a real early-day East Texas experience.

Germany for a time was faced with taming a gusher.

Georgsdorf 98, an old well in an old field in the Emsland district about 15 miles southeast of Schoonebeek field, blew wild for several days. Before the well finally settled down it had tossed a lake of mud and crude oil over the surrounding countryside. The oil covered about 30 acres, to a depth of as much as 7 ft. in spots.

First reports on the blowout indicated that West Germany must have a new and startling discovery. Last week came the explanation.

Apparently the field's repressuring project went wrong. Gas injected into Georgsdorf 96 escaped into a shallow Tertiary sand zone through a faulty cement job. The gas migrated through the sand until it reached No. 98 and then blew out around the casing of the second well. It cratered an area 130 ft. across before the gas pressure subsided and the well returned to normal.

French Get Four Wells

THE FRENCH COMPANY drilling in the Gabon region of French Equatorial Africa has brought in four more wells in its exploration and development program.

Ste. des Petroles d'A.E.F. drilled two of the wells at Pointe-Clairette, a small field on a peninsula connected with the Ogoue River delta.

The two other wells were wildcats in other areas of the delta. A well at M'bega tested 50 bbl. per hour from 2,560 ft. Another well, at Animba, tested 9 bbl. per hour from 1,650 ft.

The company is drilling ahead at 7,470 ft. at M'bilape, where oil shows were found. It also has a well further down the Atlantic Coast at Pointe-Indienne in the Middle Congo.

Pointe-Clairette has the advantage of nearness to tidewater. Part of the field lies within the city limits of Port Gentil. The company also has another small field at Ozouri, 20 miles south. Both areas produce from shallow salt-dome structures.

The first test batch of crude from the fields was shipped to France for refining earlier this year.

Cooling with Air AND MINIMUM WATER IN A MODERN REFINERY

Process cooling in Cosden Petroleum Corporation's new West Texas refining units is largely by direct use of air. Over 250 million BTU's per hour are dissipated directly to five billion standard cubic feet per day of air moved by 38 fans in HUDSON Solo-aire or Combin-aire units.

Solo-aire units are used where low effluent temperatures are unnecessary. Combin-aire units, in which air is first precooled with water, are used where lower effluent stream temperatures are required. The cooled water from the Combin-aires is available for other cooling services; the Combin-aires in this case performing the further function of water cooling towers. Water spray, carryover or condensation is impossible as the effluent hot air is under saturated with water vapor. Combin-aires are installed adjacent to other process equipment.

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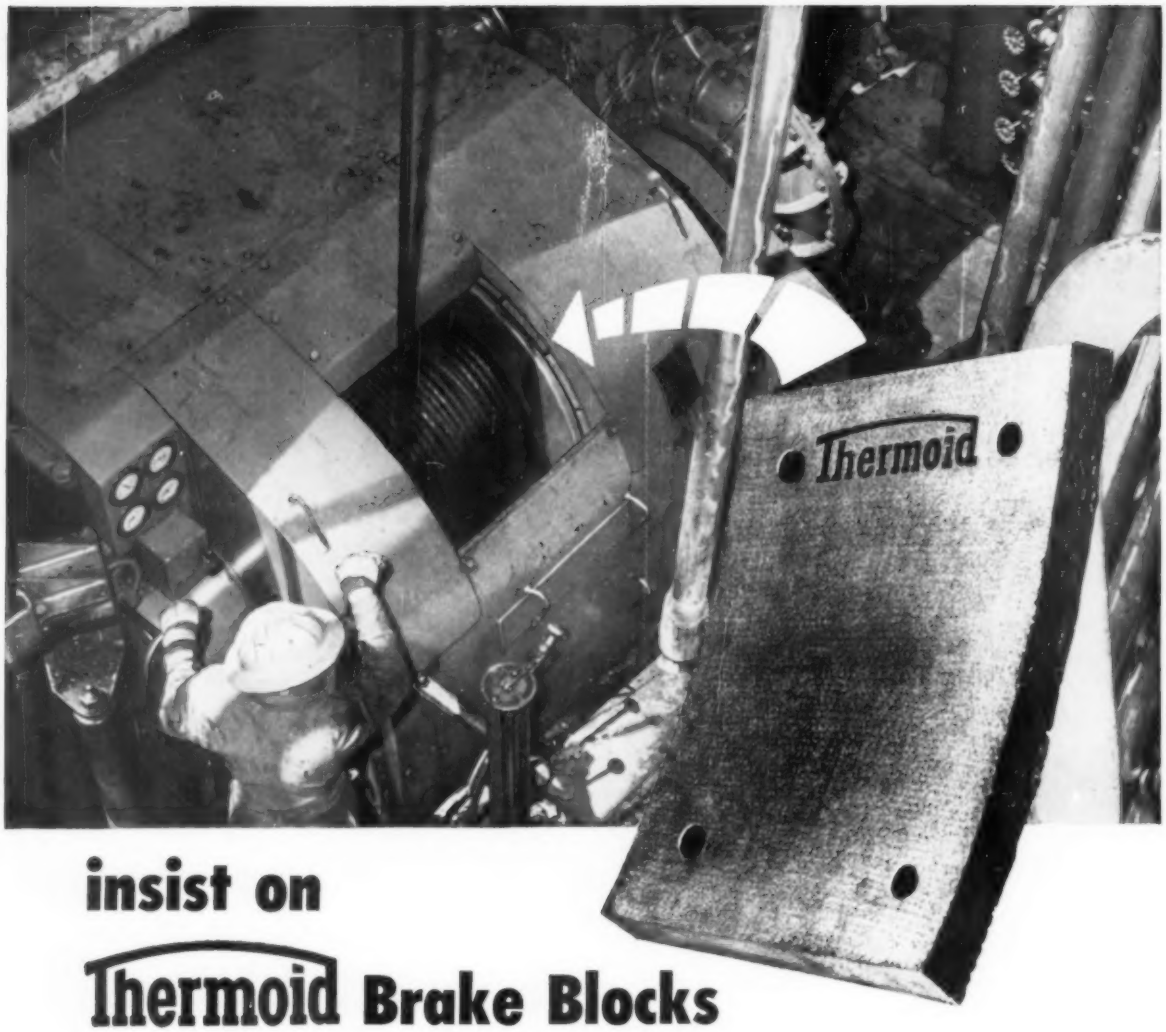

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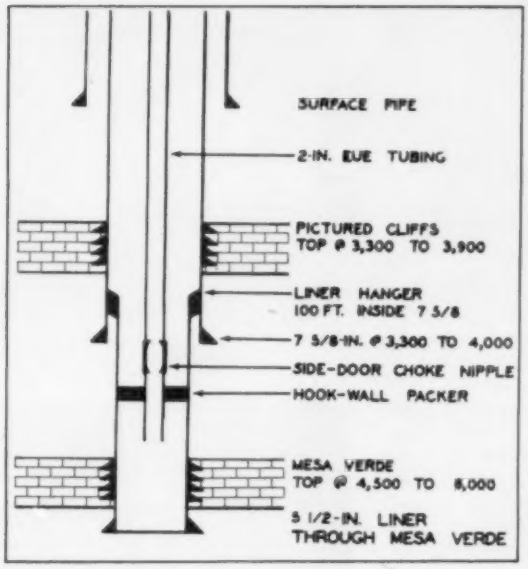


DUAL COMPLETION for a typical gas well in the San Juan basin is made as shown in this sketch. Fig. 1.

A COMPLETION RIG such as this one is brought in by some operators after the liner is cemented. Fig. 2.

In San Juan basin gas wells . . .

Liner Completions Make Low-Cost Duals

Gas drilling has been called the thing that first made San Juan basin gas wells economic. Of course, drilling with gas has drawbacks of its own, such as the need for intermediate protective pipe. In some parts of the basin, operators are now making a virtue out of that necessity by running a liner below the intermediate string instead of a full string of pipe. Then, perforating a zone behind the "intermediate" string and a zone behind the liner makes a low-cost dual. This practice is one that could save money in some other areas.

By Ed McGhee
District Editor

A TYPICAL gas-well dual completion as is now made in the San Juan basin is shown in Fig. 1. Notice that the upper zone, the Pictured Cliffs sandstone, is cased off by 7⅝-in. o.d. pipe while the lower zone, the Mesaverde sand, is cased off by a 5½-in. liner. These are the advantages of such a completion:

- The 7⅝-in. is necessary as an intermediate string even if the Mesaverde is completed singly.
- The 5½-in. liner costs less than a complete string of 5½-in.
- Although it's behind an intermediate string, the Pictured Cliffs is perforated through only one string of pipe.
- The large annulus allows dual tubing strings down to the Pictured Cliffs.

In parts of the San Juan basin, both Mesaverde and Pictured Cliffs formations are gas productive. Neither zone has a high pressure and neither makes much gas compared to wells in many other areas. These facts make a simple, low-cost dual completion even more attractive than it would be otherwise.

Fortunately, drilling programs can be the same for both dual and single completions. And, cost is kept down by drilling all the hole possible with gas as the circulating fluid. After setting surface pipe, the operators drill through all water-carrying zones with a native mud. Then they set an intermediate string and gas drill to total depth below the Mesaverde.

One operator sets an intermediate string of 7⅝-in. pipe in a 9⅝-in. hole drilled 100 ft. into the Lewis shale. This formation lies at some 3,300 to 4,000 ft. depending on topography. Moreover, the Lewis lies just under the Pictured Cliffs, so the 7⅝-in. pipe cases off that zone as well as the shallower water zones.

Run liner on drill pipe . . . At total depth—between 5,000 and 6,300 ft.—a liner is run on the drill pipe. Usual diameter of the liner is 5½ in. and its length is enough to extend completely through the Mesaverde and overlap about 10 ft. into the 7⅝-in. casing.

Cement is displaced around the liner with enough extra to bring cement above the liner hanger. Then, the drill pipe is disconnected from the liner and reverse circulation started. If some cement is reversed out, the liner is apparently cemented completely and the liner-hanger seal is set.

If no cement is circulated out after the primary job, about 50 sacks are

THE PERFORATING TRUCK, second from right, waits for the end of a stage of a fracturing job in the Mesaverde. Fig. 3.

pumped around the top of the liner in a bradenhead squeeze. Excess cement is reversed out and the liner seal set.

Complete in a hurry . . . As soon as the liner is cemented, some operators move off the rig which drilled the well and bring in a completion rig like that in Fig. 2. Very often, this completion rig is a cable-tool machine. But in some cases the rig which drilled the well also completes it.

As soon as the hole is cleaned out to bottom, gamma-ray and neutron logs are run and the Mesaverde perforated. Fracturing equipment sets up on location during perforating and, as soon as the job is over, fractures the Mesaverde. Meanwhile, the perforating truck remains at the well and readies for another run. The perforating truck can be seen in Fig. 3, waiting for the end of a stage of a fracturing job. When the Mesaverde has been fractured, the perforating truck runs a bridge plug above it and perforates the Pictured Cliffs. The fracturing equipment stands by during perforating and treats the Pictured Cliffs as soon as the gun is out of the hole.

Both fracturing jobs are done down the casing with no tubing in the hole. Almost all jobs use ball perforation sealers. Fig. 4 shows the balls being placed before being "slugged" in during a fracture job. Very often, injection rates approach 100 bbl. per minute on these treatments with water. Total elapsed time from start of the first perforating job to end of the second fracture job is seldom more than 16 hours.

Plug out, packer in . . . The bridge plug between the two zones is retrieved with tubing. First, though, it's necessary to run a sand pump on the sand line to remove the sand and rubber balls which fall onto the bridge plug during treatment of the Pictured Cliffs. During these operations, of course, the well is dead since it is filled with water from the fracture job.

With the bridge plug out, tubing is staged into the hole and all water is jetted out with drilling gas. As the water level falls in the hole, the two formations naturally begin to flow. The well is allowed to produce in this way until both zones clean themselves of sand and water from the fracture treatment.

The tubing is then stripped out of the hole and stripped back into the hole with a hook-wall packer on it. To keep the well from flowing through the tubing, a wire-line retrievable plug is run on bottom. With the packer at its proper depth in the 5½-in. liner, it is set and weight applied. The tubing plug is pulled, and the well is ordinarily ready for production.

The only extra equipment in the tubing string is a side-door-choke nipple just above the packer. This makes it possible to circulate and clean sand out of the tubing. It also makes possible producing the Pictured Cliffs through the tubing; this is done by opening the side-door choke and plugging off the tubing below. In many cases a small second string of tubing is run in the 7⅝-in. annulus to produce the Pictured Cliffs.

This side-door choke nipple is also needed sometimes when the tubing string is run into the well. If the well is dead, the side door is left open and both zones can be swabbed in through the tubing. Then, a straight-through nipple can be run to put the well onto production.

Some triples too . . . There is a third sand productive in some parts of the basin. This is the Dakota that lies at 7,000 to 8,000 ft. When the Mesaverde well is "dusting" (drilling with gas and finding no water in the hole), it can drill to the Dakota in an additional 2 or 3 days. The Dakota is higher pressure than either Pictured Cliffs or Mesaverde and is usually more productive.

As a result, where all three zones are productive, there is good argument

BALL PERFORATION SEALERS are used in almost all fracturing jobs. Here the balls are being placed before being slugged in during the fracturing operation. Fig. 4.

to triply complete them. One operator has tried this experimentally on two wells. The 5½-in. liner through the Mesaverde was simply extended down through the Dakota. After fracture treatments, a wire-line production packer was set between the two zones. A hook-wall packer on tubing was then run and set above the Mesaverde.

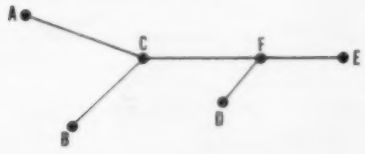
The company also ran two 1¼-in. siphon strings; one in concentric with the 2½-in. production tubing and the other is parallel to it. The concentric 1¼-in. string handles production from the Dakota. Production from the Mesaverde rises in the annulus between that string and the 2½-in. The parallel 1¼-in. string handles the Pictured Cliffs gas.

Little difficulty . . . So far, operators in the basin have had little trouble producing their dually completed wells. The only operational problem has been sand erosion of the tubing string opposite perforations of the upper zone. Sometimes, erosion has been bad enough to cut completely through the tubing and bring communication between the two producing zones. Several different methods have been tried to solve this difficulty, but there has been no general solution.

Design of Low-Pressure Gathering Stations

By Dr. John M. Campbell
Chairman, School of Petroleum Engineering,
University of Oklahoma

IN THOSE instances where a complex, low-pressure casing-head-gas system is to be designed, the use of the gas-flow equations becomes tedious. This is particularly true where several lines enter a single trunk line, as shown below.



Normally, only pressures A, B, and D at the lease separators, and pressure E, the compressor suction, are known or specified. System design, therefore, involves a trial and error solution, for each line must be sized so that unknown pressures C and F are reasonable. If this is not done, one or more of the lines might be overly large and/or the separator batteries will not be uniformly served.

Figs. 1 and 2, and Table 1, offer a simple, yet accurate solution for the problem where the system pressure does not exceed 50 psig. Figs. 1 and 2 show the flow rate for a given pressure drop, and line size when processing an 0.8-specific-gravity natural gas with a line length of 5,000 ft. P_1 is the highest pressure, and P_2 the lowest pressure in the single line. The value Q' thus obtained may be corrected for lines of other lengths and gases of other specific gravities by using the factors shown in Table 1 as multipliers.

TABLE 1

The following factors are to correct the results obtained in Figs. 1 and 2 for different line lengths and gas specific gravities in the equation

$$Q = ABQ'$$

where Q' = flow rate for 0.80-sp.-gr. gas in a 5,000-ft. line.

Length, ft.	Factor A	Length, ft.	Factor A
500	3.16	4,500	1.05
1,000	2.23	5,000	1.00
1,500	1.83	6,000	0.91
2,000	1.58	7,000	0.84
2,500	1.41	8,000	0.79
3,000	1.29	9,000	0.75
3,500	1.19	10,000	0.71
4,000	1.12	20,000	0.50

Sp. gr.	Factor B	Sp. gr.	Factor B
0.60	1.15	0.85	0.97
0.65	1.11	0.90	0.94
0.70	1.07	0.95	0.92
0.75	1.03	1.00	0.89
0.80	1.00		

Example . . . 2.5 M.M.c.f.d. of 0.68 specific gravity gas are produced from a separator operating at 35 psig. If it has to be carried through a line 2,100 ft. long to compressor suction at 28 psig., determine the diameter needed.

Solution . . . $P_1^2 - P_2^2 = (35 + 14.7)^2 - (28 + 14.7)^2 = 645$.

By interpolation from Table 1:

$$A = 1.55 \text{ and } B = 1.09$$

For 4-in. line (from Fig. 2):

$$Q' = 0.77$$

$$\text{and } Q = (0.77)\ (1.55)\ (1.09)$$

$$= \mathbf{1.3\ M.M.c.f.d.}$$

For 6-in. line:

$$Q' = 2.07$$

$$\text{and } Q = (2.07\ (1.55)\ (1.09)$$

$$= \mathbf{3.5\ M.M.c.f.d.}$$

Therefore, a 6-in. line would be specified, since it is the smallest that will handle the necessary volume.

In the complex system which is shown above, a series of calculations such as that above would be carried out for several assumed values of pressures C and D. The best combination of pressures and line size could then be chosen.

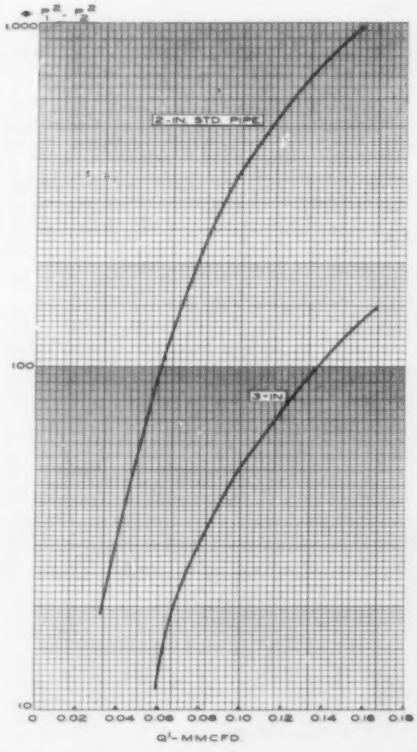


Fig. 1

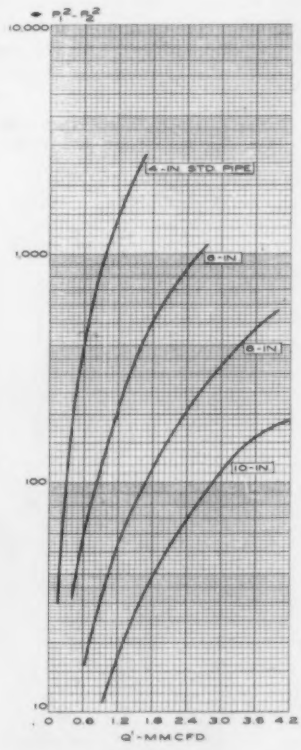


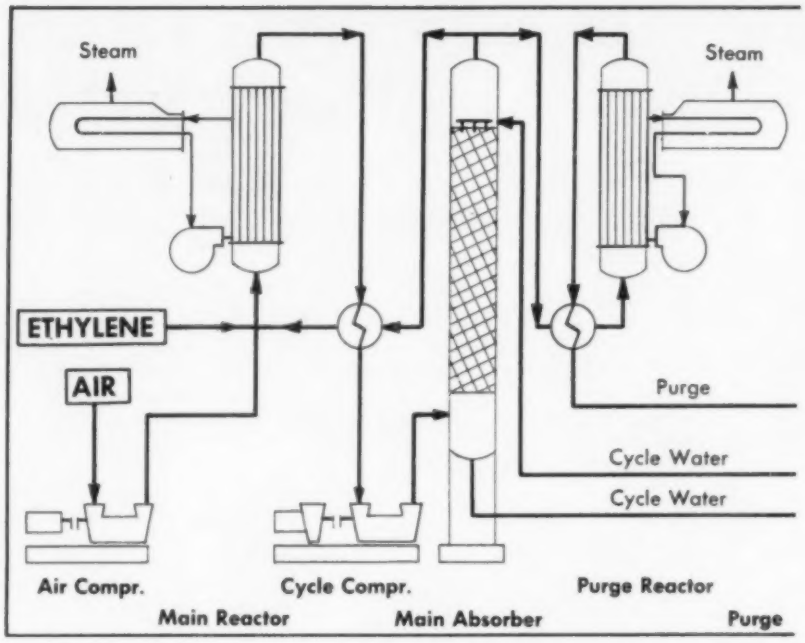
Fig. 2

PRESSURE DROP as a function of flow rate for low-pressure gathering systems. Specific gravity of gas is 0.8, and length of flow line is 5,000 ft.

PART 1

Ethylene Oxide by the

By Peter W. Sherwood
Chemical Engineer



Simplified process flow sheet of Scientific Design

ETHYLENE OXIDE accounts for the largest single use of ethylene. In 1955, it accounted for 30 per cent of the entire ethylene output of 3 billion pounds, overshadowing such important other consumers as: ethyl alcohol (26 per cent), polyethylene (14 per cent), styrene (11 per cent), and ethyl chloride (9 per cent).

It is expected that ethylene oxide will maintain its leading position among ethylene consumers. For 1960, Kuhn and Hutcheson[1] forecast the following ethylene distribution pattern: Ethylene oxide, 30 per cent; ethyl alcohol, 24 per cent; polyethylene, 20 per cent; styrene, 10 per cent; ethyl chloride, 8 per cent; other, 8 per cent.

Ethylene Oxide-Glycol Growth

In all, ethylene oxide production in 1955 has been estimated at 910 million pounds and a recent forecast places 1960 output at the 1,250-million-pound level.

Thus, ethylene oxide production volume c[illegible]es the strong upward trend has characterized its growth throughout the last two decades, (with a temporary dip in 1953-54), and most particularly since 1947 when production was just short of 200 million pounds.

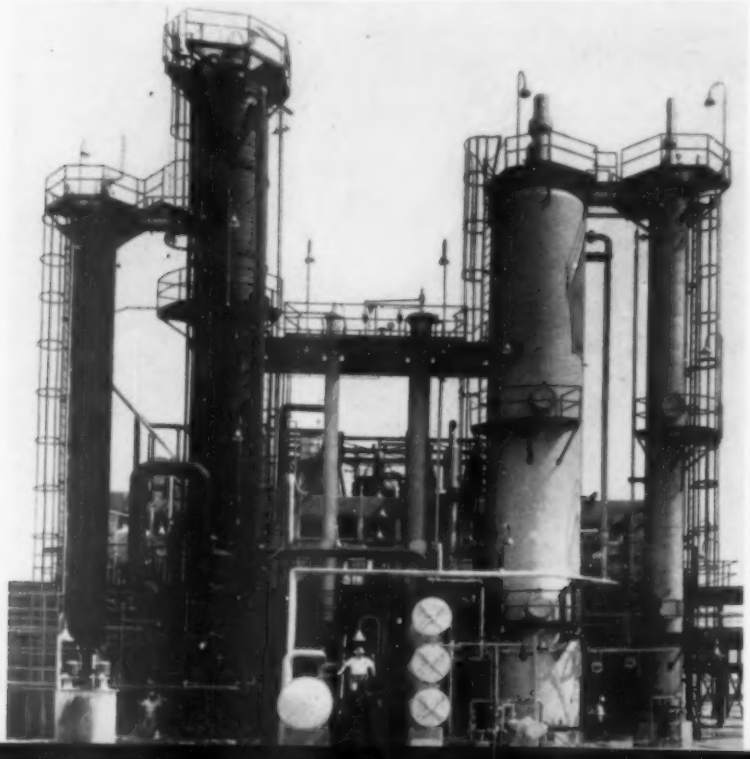
Most of this growth has been related to the increasing demand for ethylene glycol—chiefly as antifreeze. This derivative, which accounted for some 70 per cent of ethylene oxide production, continues to be important but its share of the ethylene oxide market is expected to decline as other consumer chemicals expand at a faster rate. Thus, one may predict from current trends that ethylene glycol will consume only some 60 per cent of ethylene oxide production in 1960-62.

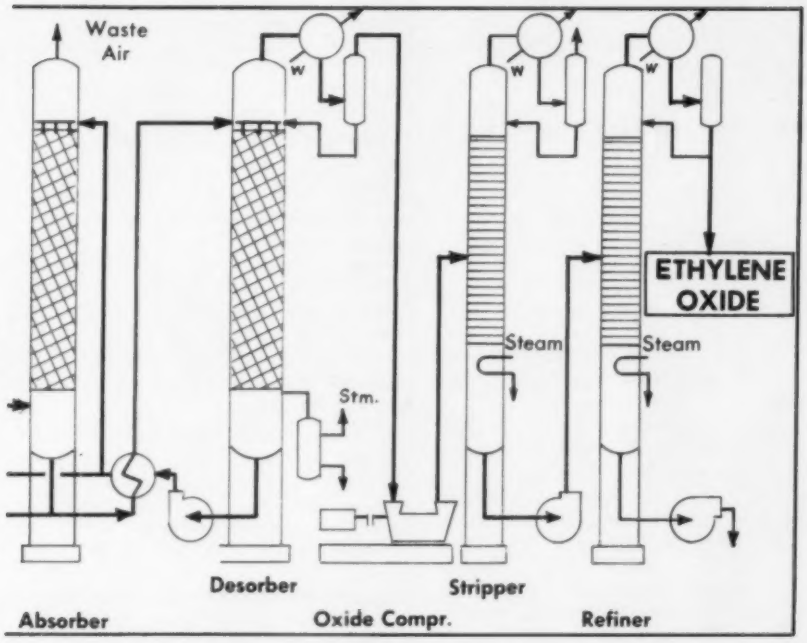
The shifting distribution pattern for ethylene oxide during different years is summarized in Table 1.[3]

The continuing bright prospects for ethylene oxide have spurred expansion of plant facilities for its production. During the period 1953-1958, U. S. capacity for ethylene oxide is being doubled. By early 1959, plants which are now on stream or under construction will be able to turn out an estimated 1.48 billion pounds per year. This compares with an installed ethylene oxide capacity of 745 million pounds at midyear 1953, 1.1 billion pounds at the end of 1955.

Direct oxidation . . . Most of the new capacity is based on the direct oxidation of ethylene. By the early part of next year, some 57 per cent of plant

DIRECT OXIDATION of ethylene to make ethylene oxide is employed at Allied Chemical & Dye Co.'s plant at Orange, Tex.





Co.'s direct-oxidation ethylene oxide method.

Direct Oxidation Process

Here are some of the objectives and problems involved in making ethylene oxide by direct oxidation. The second and concluding part, to appear in an early issue, will deal with the choice and effect of operating conditions.

capacity will be based on this process. This is a reversal of the picture in 1953, when the classical chlorohydrin route accounted for 58 per cent of the country's production potential for ethylene oxide.

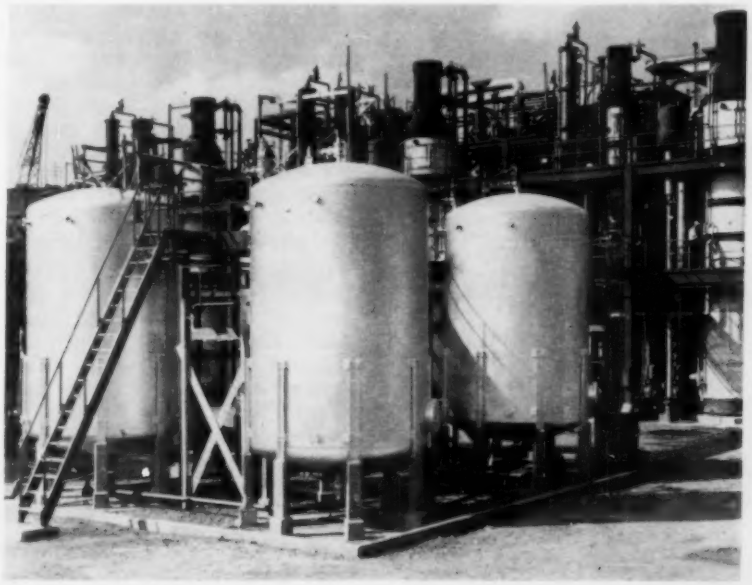
Several factors account for this new ascendence of the direct oxidation process over competitive chlorohydrination:

- Most important is the rise in chlorine price during recent years. Each pound of ethylene oxide produced by the chlorohydrin route consumes 2.1 lb. chlorine and yields, as byproduct, 0.2 lb. ethylene dichloride plus some 5.5 lb. aqueous calcium chloride.
- Of further importance has been the more general availability of low-cost ethylene in adequate concentration. Such a development would naturally tend to tilt the balance in favor of direct oxidation which consumes 1.1-1.2 lb. ethylene per pound oxide, while only about 0.9 lb. of ethylene is required per unit of product in the chlorohydrination process.
- The third outstanding factor which shares responsibility for the new activity in direct ethylene oxidation is the development of new knowledge in this field and the evolution of important process improvements which have rendered the method economically more attractive.

At today's market structure, ethylene oxide production by the chlorohydrin route in a new plant is economically attractive only at very specific conditions, which include: (1) a low-cost (i.e., uncommitted, captive) source of chlorine; (2) a steady market for byproduct ethylene dichloride, e.g., for vinyl chloride or as scavenger for antiknock compound. Also helpful is a market for byproduct calcium chloride.

Chlorohydrin route . . . During the last 4 years, only two manufacturers have chosen the chlorohydrin route to provide significant new ethylene oxide facilities: Dow Chemical Co. added 90 million pounds per year capacity at Freeport, Tex.; 60 million pounds at Plaquemine, La.; and Olin-Mathieson expanded its ethylene oxide plant at Doe Run, Ky., from 75 to 100 million pounds per year ethylene oxide, using the chlorohydrin route. In addition, Jefferson Chemical Co. and Wyandotte have each increased their chlorohydrin-type facilities by an estimated 10 million pounds.

The remaining 540 million pounds per year ethylene oxide capacity, which has been added since mid-1953, is based on the direct oxidation of



ETHYLENE OXIDE UNITS at Institute, W. Va., plant of Union Carbide Chemicals Co.

TABLE 1—ESTIMATED DISTRIBUTION FOR ETHYLENE OXIDE

	1950		1955		1960	
	Million pounds	Per cent	Million pounds	Per cent	Million pounds	Per cent
Ethylene glycol	312	69.3	585	64.3	760	60.8
Nonionic surfactants	25	5.5	95	10.5	135	10.8
Ethanolamines	26	5.8	65	7.1	130	10.4
Polyethylene glycols	35	7.8	80	8.8	110	8.8
Acrylics	26	5.8	52	5.7	70	5.6
Glycol ethers	26	5.8	33	3.6	45	3.6
Total	450		910		1,250	

ethylene. It is interesting to note that there was only one producer (Carbide & Carbon Chemical Co.) who practiced direct oxidation in 1953, but that there will be no fewer than six manufacturers in the field in early 1959. The lineup of producing plants at these key dates is shown in Table 2.[3,6,7,8]

Problems in Ethylene Oxidation

The direct ethylene oxide process involves the reaction of ethylene with molecular oxygen in the presence of a silver catalyst.

$$C_2H_4 + 1/2\ O_2 \rightarrow C_2H_4O + 29.2\ \text{Kcal}\ (280^\circ\ \text{C.}) \quad (1)$$

This conversion is accompanied by a side reaction leading to the complete combustion of ethylene:

$$C_2H_4 + 3\ O_2 \rightarrow 2CO_2 + 2H_2O + 317\ \text{Kcal}\ (280^\circ\ \text{C.}) \quad (2)$$

Other than this, there are no significant side reactions. The only organic impurity which is detected in the product is a small amount (<0.2 per cent) acetaldehyde which is formed by isomerization of ethylene oxide. In addition, there are some nondescript degradation reactions which lead to the gradual fouling of catalyst.

Because of the substantial absence of organic byproducts, the purification stages of ethylene oxide processes are fairly simple. The product is absorbed in water under pressure (150-200 psi.). Dissolved ethylene oxide is removed from aqueous solution by stripping and is concentrated by fractionation.

Reaction . . . By contrast, the reaction stage of ethylene oxidation is highly complex. No fewer than six basic objectives must be met here by an ethylene oxide process in order to be commercially useful. The problems, and the controlling variables, are as follows:

A. High Selectivity of the Reaction

1. Definition. The term "selectivity" denotes the number of moles ethylene oxide formed per mole ethylene reacted.

2. The problem. There are two reasons why high selectivity is desired:

(a) High selectivity is one needed requirement to minimize raw materials consumption.

(b) A look at Equations 1 and 2 shows immediately that the heat evolved by ethylene oxide formation is small compared to that accompanying complete combustion. It can be readily shown that the useful conversion to ethylene oxide contributes only 8.4 per cent of the total heat evolved at 50 per cent reaction efficiency. Even at 65 per cent selectivity (which is close to the practical limit at the present state of the art), the desired reaction (1) contributes only 14.6 per cent of the 8,180 B.t.u. released per pound of product.

The complete combustion reaction is, thus, chiefly responsible for the elaborate heat removal system which must be provided to keep the reaction system within the close permissible temperature limits. High selectivity is, therefore, an essential factor toward keeping investment cost in reaction equipment low.

3. Controlling variables. Catalyst composition, temperature, conversion per pass, ratio and concentration of reactants, contact time, use of inhibitors. These variables are largely interrelated. Furthermore, the content of lower paraffins, oxidation of which contributes heat of reaction, is to be held to a minimum.

B. High Over-all Yield on Ethylene

1. The problem. Good reaction selectivity by itself does not answer the need for high yield on ethylene oxide. To obtain high selectivity, it is necessary to operate at only partial ethylene conversion per pass (generally between 30 and 40 per cent). A certain amount of bleedstream must be withdrawn continually from the reactor in order to purge inerts (chiefly carbon dioxide from Equation 2 and nitrogen introduced with the feed). This bleedstream contains ethylene which constitutes a loss once it leaves the ethylene oxide process.

TABLE 2
Ethylene Oxidation Plants in the United States
(Million pounds per year)

Company and plant—	Capacity— Mid-1953	Capacity— Early 1959
Allied:		
Orange, Tex.		35
Calcasieu:		
Lake Charles, La.		60
Carbide:		
South Charleston, W. Va.	20	30
Texas City, Tex.	150	150
Whiting, Ind.	70	70
Institute, W. Va.	70	70
Seadrift, Tex.		205
Torrance, Calif.		50
General Aniline:		
Linden, N. J.		60
Jefferson:		
Port Neches, Tex.		60
Wyandotte:		
Geismar, La.		60
Total	310	850

2. Controlling variables. Reaction selectivity, per pass conversion, amount of inerts introduced with feed gas, amount of ethylene recycled to reaction stage, utilization of effluent ethylene in secondary reactors.

C. Long Catalyst Life

1. The problem. In the course of its on-stream life, catalyst activity and selectivity decline and pressure drop increases (the permissible limit in a fixed-bed reactor is 40-50 psig.). It then becomes necessary to exchange the catalyst, with resulting down time and catalyst replacement cost. The objective is to have the useful catalyst life as long as possible. On-stream time of 1-2 years is within commercial experience.

2. Controlling variables. Catalyst preparation, operating temperature and pressure, impurities in feed gases.

D. Operating Safety

1. The problem. It is necessary to operate outside the explosive range for ethylene and oxygen. At normal operating conditions, this calls for an oxygen concentration below 8 per cent (usually 5-6 per cent) and for an ethylene content not exceeding 5 per cent (usually 3.5-5 per cent). Furthermore, the presence of certain impurities—notably hydrogen or acetylene—in the feed gas constitutes a hazard.

2. Controlling variables. Elimination of hazardous impurities, ratio of recycle to feed gases.

E. High Throughput

1. The problem. Within certain limits, throughput per unit reactor space has a significant effect on the plant's first cost.

2. Controlling variables. Catalyst preparation, temperature, pressure, efficacy of heat removal.

F. Efficient Heat Removal and Temperature Control

1. The problem. The highly exothermic reaction system must be held within narrow temperature limits to prevent a runaway complete combustion reaction (at high temperature) or excessive slowdown of the conversion (at low temperature). Most particularly, the formation of local hot spots on the catalyst must be avoided since it may lead to runaway reactions.

2. Controlling variables. Fluidized vs. fixed-bed catalysts. In fixed-bed methods (which covers all present commercial units): catalyst distribution, design of heat-exchange tubes, use of inhibitors (to avoid hot spots), choice of catalyst support (minor effects).

To summarize, there are 12 variables which can make or break an ethylene oxide process—assuming, of course, that general engineering and construction work is carried out satisfactorily. These variables are listed as follows: (1) catalyst preparation, (2) use of inhibitors, (3) operating temperature, (4) contact time, (5) pressure, (6) impurities in feed gases, (7) reactants' ratio and concentration, (8) per pass conversion, (9) recycle ratio, (10) inerts in feed gas, (11) after processing of reactor gas, and (12) fluidized or fixed-bed catalytic operation.

There is no single combination of conditions which may be termed the ideal process. Wide flexibility is given in several (but not all) of these variables, provided that the remainder of the process is adjusted to their setting.

Processes . . . In the second and final part of this article, we shall consider the effect of these variables on process performance, and considerations which guide the selection of design and conditions. Wherever possible, these aspects will be viewed in the light of the processes who have proven commercially successful, or which are ready for commercial realization. There are five processes in this category:

1. Carbide & Carbon Chemicals Co., employed by Carbide's own plants.

2. Scientific Design, employed by General Aniline, Allied.

3. Shell, employed by Wyandotte, Calcasieu.

4. I. G. Farbenindustrie, Zweckel, Germany—none in U. S.

5. Vulcan - Atlantic, through pilot plant, not yet commercialized.

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Hexane Splitter Will Help Improve Octane Number

THIS 200-ft. 120-ton fractionation column is a hexane splitter. It is going into California Oil Co.'s Perth Amboy, N. J., refinery as part of a superfractionation unit designed to separate normal hexane from straightrun gasoline.

The unit comprises two main towers, each 10 ft. in diameter. Light naphtha from the crude unit is charged to the first column which produces isohexane and lighter as an overhead stream, and a bottoms stream of normal hexane and heavier. The second column looming 163 ft. high will produce an overhead of narrow-boiling normal hexane. Caloil is marketing this fraction as a top-quality commercial solvent.

Gasoline octane will be improved by subtraction of this low-quality, 24.8 research-octane-number clear fraction from the motor fuel stream. The unit is capable of taking a charge of 9,700 bbl. per day to the first column. Design work was done by California Research Corp., and the construction contract was let to M. W. Kellogg Co. The new unit is slated for completion late this year. Meanwhile, Caloil is revamping its crude unit. This job will boost crude capacity from 78,000 to 88,600 bbl. per day, when completed next spring.

INSTALLATION, operation, and maintenance of beam pumping units often afford an opportunity to reduce operating costs.

IMPROPER ALIGNMENT of the polish rod may be caused by the wire-line hanger and polish-rod support.

Are Your Pumping Units

By John Pickens

RESPONSIBILITY for proper care and maintenance of pumping units falls primarily on field personnel of oil companies. Most installations are handled by local contractors who follow manufacturers' recommendations. Field personnel usually assume their responsibility after erection when a well is ready to pump.

However, the responsibility of field personnel should overlap that of the contractor. The correctness of an installation should be checked because a large percentage of failures may be traced to incorrect installation or erection of equipment.

... **First consideration** is the foundation. Manufacturers recommend a solid reinforced-concrete block on which grouting is used. The soil should support at least 2 tons per square foot but if soil conditions are poor, foundations may be enlarged. Second, the block must be thoroughly cured before the pumping unit is operated.

... **Proper installation** of the pumping unit depends on many things. The following discussion shows what should be checked and the reasons for such checks.

Author is production equipment engineer, National Supply Co., Odessa, Tex.

1. Alignment of wire-line hanger and polished rod.

Improper alignment of the wire-line hanger and polished-rod support bends the polished rod and produces uneven wear on the wire line. These conditions can be prevented by making sure that the polished-rod support is parallel to the base of the unit. On most hangers the upper seating surfaces are designed to center the well load over the beam and to align the hanger vertically over the well.

2. Alignment of unit and polished rod with well bore.

Improper alignment of the unit and polished rod with respect to the well bore will cause stuffing-box trouble, increase polished-rod wear, and possibly increase frictional load on the pump. Adjusting screws at the saddle allow approximately 3-in. longitudinal movement for alignment of the beam. There is usually approximately ½ to 1-in. between the arc hanger and walking beam for lateral alignment of arc hanger to center the polished rod in tubing. The fit of the bolts in the holes at the saddle and pitman top bearing connections is loose enough to allow some additional adjustment of the beam over the well center. Also some lateral adjustment is usually allowed by the fit of the saddle bearing on the samson post.

3. Vertical alignment of pitman arms.

The pitman arms should be vertical to the base of the unit to assure proper alignment of walking beam to center line of the base. This is accomplished by aligning the pitman arms and walking beam before tightening the pitman bolts and walking beam to saddle connection. This will help to assure satisfactory performance of the wrist-pin bearings.

4. Sheave alignment and V-belt tension.

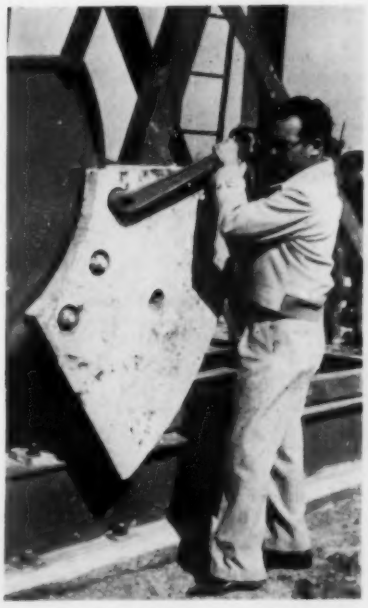
Improper alignment of sheaves and incorrect belt tension will result in poor V-belt service, possible trouble with clutch and pilot bearing of the prime mover, and sometimes gear failure in the gear box. Too much tension will increase loads on the clutch and bearings, and slipping of the belts will cause load reversals on gear teeth and a hammering action in the gear box.

5. Samson-post position.

To be sure the samson post is correctly positioned, a plumb bob should

PITMAN ARMS should be vertical to the base. Calipers may be used to check.

CORRECT POSITION of the samson post is shown by plumb bob centered at base.



COUNTERWEIGHT NUTS should be tightened properly and checked periodically.

Expensive to Operate?

Better installation, operation, and maintenance of beam pumping units can often reduce costs of oil production. Here are some timely suggestions on how to get best service from pumping equipment.

PROPER lubrication procedure gives wrist pins and bearings longer life.

be dropped from its center to the center line of the base. This will help assure proper alignment of the unit and prevent variable loads on saddle bearings. Good alignment is also amply assured when the pitman arms are equidistant from the cranks and the arc aligned over the well.

6. Tightness of all structural bolts.

Loose structural bolts are apt to result in fatigue failure of the loose member of the unit.

7. Tightness of wrist-pin nuts.

Wrist-pin failure will result from insufficient tightening of wrist-pin nuts. This failure will usually result in costly damage to the pumping unit. Field personnel are responsible for the tightening of these nuts.

8. Tightness of counterweights.

To prevent slipping of counterweights on the crank or walking beam, the tightness of nuts on holding bolts should be checked by field personnel before starting a pumping unit.

9. Tightness of foundation bolts.

If foundation bolts are not tight the base is subjected to fatigue stresses which will result in failure and possible damage to the foundation.

10. Gear-box oil level.

The gear-box oil level is specified to prevent damage to gears and bearings and to avoid leakage problems at gaskets and oil seals from too much lubricating oil. In known instances of unit operation without oil, damage was extensive.

11. Lubrication of bearings, wrist pin, saddle, and pitman.

Operation on improperly lubricated bearings, even for a short time, damages the bearings.

12. Brake adjustment.

Safety of operating personnel is affected by brake adjustment. Well spacing and adjustment of counterweights require satisfactory operation of the brake.

13. Check unit for level.

A base that is not level will result in misalignment of the unit with the well and in uneven distribution of the well load. A level should be used on the base to make sure.

14. Check concrete block and grouting.

The concrete block and grouting should be inspected for cracks and to

". . . Correct counterbalancing is a simple one-man operation"

assure contact with the unit base. Poor base contact can cause fatigue failure in the base and foundation bolts.

All of these checks should be made again after the unit has operated for 2 weeks. This will disclose any loosening of bolts caused by vibration. Well conditions should be more stable and the counterbalance can be rechecked.

Proper Counterbalance

Proper counterbalance is the principal factor in the service of the gear box, which is the heart of the pumping unit. The torque load exerted on a gear box is determined primarily by the uncounterbalanced load. The uncounterbalanced load is approximately equal to one-half the fluid load, plus the effect of impulse factors, inertia, vibratory, and frictional forces.

Amount . . . Basically, the load on the upstroke is the weight of the sucker rods plus the fluid column being lifted. On the downstroke the load is the weight of the sucker rods only. Both of these loads are influenced by impulse factors, fluid friction, buoyancy, pump friction, inertia forces, and other factors which affect calculation of loads. The average load throughout the cycle is approximately equal to the rods plus one-half the fluid. Therefore this is the portion of load that is counterbalanced.

On the upstroke this leaves a net load on the gear reducer resulting from half the weight of the fluid. On the downstroke the net load on the gear reducer results only from the weight of the counterweights in excess of sucker-rod weight or approximately one-half the fluid lifted on the upstroke. Thus the load on upstroke and downstroke are equal.

If only sucker-rod weight were counterbalanced there would be no load on the downstroke and full fluid load on the upstroke. A similar unbalance would occur if sucker rod and full fluid weight were counterbalanced. There would be no load on the upstroke and the net load on the downstroke would be that portion of the weight of the counterweights which counterbalance the full fluid weight.

Any variation of counterweight to more or less than half the fluid load unbalances the loading on the gear reducer to some extent and keeps the unit from running as smoothly as with properly balanced loads.

How to do it . . . Correct counterbalancing can be accomplished in several ways. Six are described here.

1. The polished rod dynamometer provides the surest method of determining correct counterbalance. The dynamometer card shows graphically a counterbalance line cutting its center when upstroke and downstroke loads are equal. If the line cuts the card too high or too low it shows how much and which way the unit is out of balance. Some operators bring the counterbalance in phase with the peak load of the pumping cycle by leading or lagging the counterweights. The dynagraph will indicate the correct position for counterweights.

2. A recording tachometer will help in determining counterbalance by indicating variations in engine speed during upstroke and downstroke. To determine over or undercounterbalance, notations must be made of crank positions on the graph. The margin for error is greatest with single-cylinder engines having heavy flywheels that store enough energy to carry the counterbalance through with little change of speed.

If an engine operates with a sensitive governor, counterbalance should be tested while on hand throttle to prevent the governor from giving the false impression of a constant speed. If the counterbalance is correct, variations in engine speed will be the same on upstrokes and downstrokes. A nonrecording tachometer may be used if crank positions and tachometer readings are made simultaneously.

3. The clutch-slipping method is only as accurate as the skill of the operator. With a constant clutch lever pressure (just enough to prevent slipping), the cranks are watched for slowing at the 3 and 9 o'clock positions. If there is equal slowing or slippage the pump is properly counterbalanced. The method is simple, inexpensive, and practical, but is subject to human error.

4. The fall of the counterweights gives some operators a check on counterbalance. False impression can be created by many factors, however, and extreme caution is necessary. In using this method on a crank-counterbalanced unit, the weights are allowed to coast to a stop at the midpoint of the upstroke. If the unit is properly counterbalanced, the weights will tend to rise slowly to the top dead center. This is based on the assumption that the traveling valve is closed, which would mean that the well load is greater than the counterweight effect.

By allowing the counterweights to come to a stop at the middle of the downstroke, the weights have a tendency to drop to bottom dead center. This time the traveling valve should be open. By both of these tests the unit would be considered satisfactorily counterbalanced.

When the counterweights accelerate too rapidly or fall in the wrong direction, the unit is probably incorrectly counterbalanced. In a gaseous well the action of the traveling valve must always be considered because it often causes a false observation.

With beam-weighted units, the walking beam will remain stationary if counterbalance is correct. On wells with light fluid and rod loads the counterweights tend to remain stationary because of friction in the system. Use of this method requires a thorough understanding of well conditions.

5. Sound of the prime mover enables an operator to determine correct counterbalance by variations in exhaust explosions of an engine or of "whine" in an electric motor. In a fully loaded, two-cycle heavy-flywheel engine the exhaust is on a regular cycle in synchronism with the crank unless it is improperly counterbalanced. It will then miss exploding at a certain point in the cycle and pick up at another point. With multicylinder engines and electric motors, there will be two even variations in the exhaust or whine for each revolution of the crank.

If there is a very definite difference in these variations the unit is improperly counterbalanced. This method is more accurate if the prime mover is loaded 75 per cent or more. Operator skill is important to the accuracy of the method.

6. An ammeter is an accurate means of checking motor-driven pumps. It shows variations in amperes during the cycle. Peaks occur at approximately the middle of the upstroke and downstroke. If more amperes are required on one stroke than on the other, the unit is improperly counterbalanced.

Of these six methods three require instruments and three depend upon operator skill. Best results are obtained when two or more methods are checked against each other. Correct counterbalance is often temporary because well conditions change and must be observed continually.

Changing the rotation of the unit will result in a change of the amount of counterbalance required. When changing stroke length, remember that the counterbalance effect varies inversely with the change of stroke. In other words, on crank-counterbalanced units, increasing stroke length decreases the available counterbalance effect while decreasing the stroke length increases the available counter-

balance effect. Consequently the counterbalance must be changed after a stroke change.

The establishment of a system of periodic checks on counterbalance is recommended, taking these factors into consideration and depending on local field conditions. Manufacturers recommend the correct procedure and it is a relatively simple one-man operation with present-day crank-counterbalanced units.

Lubrication

Proper lubrication is provided if manufacturers' recommendations for lubricants and procedure are followed. Most recommend changing gear oil twice a year, or more often if the oil is found to be contaminated. It should be inspected every 3 months to check the presence of water, metal cuttings, dirt or sand. Even a small amount of water emulsifies the oil and destroys its lubricating valve.

When checking for metal cuttings, dirt, or sand, the sample should come from the highest oil level immediately after stopping the unit because this is the pickup level where dirty oil will cause damage to gear teeth and bearings. The sample should be diluted with 50 per cent gasoline and centrifuged. Water or foreign matter will settle in the bottom of the test tube.

Water in the oil . . . Most gear boxes have sediment chambers to collect condensation and foreign particles, and can be cleaned easily by removal of drain plugs. The amount of water and foreign material found by some operators who use a filtering service to clean the gear box and filter the oil is startling. Nevertheless, there is evidence that a large number of operators do not inspect this oil or change it, and report very little gear and bearing trouble.

These reports should be evaluated with consideration of the fact that failures from improper lubrication are often long delayed when units are not fully loaded. Improper lubrication accelerates wear and reduces the life of equipment at rates dependent upon loading. In fully loaded units acceleration may be rapid, thus making extra care advisable.

Type of lubricant . . . The transmission lubricant is commonly a straight mineral type of approximately S.A.E. 250, but climate and operating conditions should influence the choice. Wrist-pin bearings, saddle bearings, and pitman bearings require lubrication once a month.

Proper lubrication depends upon the type which include, principally, self-aligning roller bearings, needle bearings, bronze bushings or sleeve-type bearings, and a rubber bearing which does not require lubrication, and the application. Since bearings differ, it is not necessarily true that one lubricant is satisfactory on units made by different manufacturers. Lubrication of the pumping unit at the same time and with the same lubricant as used for the prime mover is a typical mistake.

Another common mistake is to increase the frequency of lubrication when an oil seal leaks. This increases the leaking. Usually leaking should be eliminated by replacing the oil seal if damaged or relieving excess pressure in the bearing housing.

When a unit is to be shut down for a long period of time, the bearings should be protected from moisture. A coating of cosmoline will provide good protection and the bearing may be relubricated before starting the unit again. This will protect the bearing from pitting and early failure after it is started again.

Changing Stroke Length

Changing the stroke length requires removal and installation of the wrist pin on most crank-counterweighted units. Most manufacturers provide a tapered pin and hole arrangement for wrist-pin connection to the unit crank. The wrist pin serves as the fulcrum for converting rotary motion to reciprocal motion.

It is extremely important that the installation be correct because wrist-pin failure usually results in extensive damage to the unit. To assure satisfactory installation and ease of removal, all of the well load should be removed from the unit.

To remove the wrist pin, it is necessary to break the taper lock. This is usually accomplished by hammering the wrist pin, being careful not to injure the threads. A knockout nut is desirable on a stubborn pin. Some manufacturers provide a hydraulic method which utilizes a high-pressure grease gun.

When installing wrist pin, wrist-pin hole and wrist pin must be clean. Any amount of rust, paint, or dirt will act to loosen the connection during operation, and eventual failure will occur. Some units have a locking-nut arrangement, others a cotter pin and castellated nut or an elastic stop nut. This nut should be thoroughly tightened and rechecked after the unit has operated for approximately 1 week.

Overloaded Units

After several years of operation, a unit may be badly overloaded, usually because of unexpected changes in pumping conditions. Experience has proved that overloading will greatly reduce expected service life. Tests have indicated that the life of bearings and gears is approximately inversely proportional to the cube of the load. If a unit were overloaded 50 per cent or operated at 150 per cent of its rating, the expected life would be reduced by 70 per cent.

Gear teeth . . . Experience has indicated that all of the gear teeth are not necessarily subject to this overload condition. Usually, a comparatively small percentage of the teeth in the crank gear are in contact during that part of the pumping cycle when the unit is overloaded. There will also be another small section of teeth that are in contact during periods of load reversal on the gear teeth. These areas will be the first to experience tooth failure.

It is possible to distribute this overload to other teeth by changing the pumping cycle. This can be accomplished by reversing the direction of rotation, changing counterbalance, changing stroke lengths or pumping speeds. A careful inspection of the gear box will reveal when load distribution is necessary, and at the same time damaged gears and bearings may be changed before failure occurs.

From the standpoint of maintenance, operators should be exceptionally careful to see that a unit is operated in strict accordance with manufacturers' recommendations.

In some instances it is possible to reduce the well loads and still maintain allowable production. Well conditions should be investigated when considering changes in pump bore, sucker-rod design, and pumping speeds. It may be possible to use a smaller pump at a greater speed, shorter stroke lengths with faster pumping speeds, redesigned rod string to increase efficiency of production, etc. A complete dynamometer analysis will guide selection of the most advantageous over-all installation procedure.

Manufacturer Cooperation

Unit operation is most satisfactory when there is cooperation between the operator and the manufacturer. Manufacturers are willing and ready to provide operators with the service and information necessary to locate and solve any problems that might occur in the operation of equipment.

For a manufacturer's representative to arrive intelligently and accurately at a satisfactory solution, complete and accurate information from the operator is necessary. When there is close cooperation, the operator will experience the most economical and trouble-free operation of pumping equipment. **End.**

Pipeline-Flow Efficiency Testing

The first article of this series discussed the test equipment and procedures which should be used to obtain valid experimental data for calculating pipeline-flow efficiency. In the second article, the equations required for calculating flow efficiency were presented and discussed and their use illustrated in a sample calculation. This, the final article, discusses errors which may occur in measuring various quantities and the effect each has on the final result.

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3. Analysis of Test Results

THE FLOW efficiency of a pipeline is calculated by dividing the measured flow, for a given set of operating conditions, by the flow calculated for these conditions by use of a flow equation of the Weymouth or Panhandle type. The accuracy of the calculated flow efficiency depends on the accuracy with which each quantity entering the calculation is measured. Therefore, it is important that the effect of errors, or uncertainties, in the measured quantities required for calculation of pipeline be determined.

It is necessary first to establish the variations which can be expected in the measured quantities themselves and then the variations in the calculated efficiencies which may be expected to result from random errors in measurements. This can be done by use of some of the basic concepts of statistical treatment of data.

Such an analysis will permit the test engineer to estimate the precision with which each measurement must be made to secure a reliable result. It will permit the test engineer to analyze the data from a given test and estimate the accuracy of the calculated flow efficiency. It will also provide a basis for judging whether variations in calculated efficiency for a given line segment are the result of random variations in measured quantities or from line conditions meriting investigation.

The various physical measurements affect the calculated efficiency in a complex manner. This can be seen in Equation 1, for the case in which flow rates are measured by use of the ammonia-tracer technique and the Weymouth equation is used to predict the flow. The nomenclature for this equation is the same as used in Parts 1 and 2 of this series. Because of the complexity of this relationship and the fact that the errors in each measurement are difficult to determine, the analysis of errors requires careful consideration.

$$E = \frac{Q_{b,obs}}{Q_{b,calc}} = \frac{41469 L D^2 \frac{2}{3}\left(\frac{P_1^3 - P_2^3}{P_1^2 - P_2^2}\right) T_b / \theta P_b T_{avg} z_{avg}}{43349 \frac{T_b}{P_b}\left[\frac{P_1^2 - P_2^2 - \left[0.0375 F (h_2 - h_1) 4/3 \left(\frac{P_1^3 - P_2^3}{P_1^2 - P_2^2}\right)^2 / z_{avg} T_{avg}\right]}{G T_{avg} L z_{avg}}\right]^{0.5} D^{8/3}} \quad (1)$$

Applying Statistical Methods

The error in a pipeline-flow efficiency test result could be determined exactly if it was possible to determine exactly the magnitude of the error existing in the measurement of each of the quantities required in an efficiency test. Ordinarily, however, only an estimate of the range within which the errors for each measurement should fall is available. Also, the errors in the individual quantities are not likely to be interdependent so that they may tend to cancel out, so it is difficult to determine the final error to which a given pipeline efficiency test is subject.

An insight into the effect of individual errors may be obtained, however, if certain assumptions are made regarding the frequency with which errors of given magnitudes will arise in each measurement. In particular, if it is assumed that the errors in the measurements required in pipeline-flow efficiency test work are normally distributed, the resultant error in flow efficiency is also normally distributed, according to the following relationship:[1]

$$\sigma_E^2 = \left(\frac{\partial E}{\partial P_1}\right)^2 \sigma_{P_1}^2 + \left(\frac{\partial E}{\partial P_2}\right)^2 \sigma_{P_2}^2 + \left(\frac{\partial E}{\partial G}\right)^2 \sigma_G^2 + \left(\frac{\partial E}{\partial T}\right) \sigma_T^2 + \left(\frac{\partial E}{\partial z}\right)^2 \sigma_z^2 + \left(\frac{\partial E}{\partial Q}\right) \sigma_Q^2 + \left(\frac{\partial E}{\partial \Delta H}\right) \sigma_{\Delta H}^2 \quad (2)$$

in which:

$\delta E/\delta X_i$ = the rate of change of E with respect to a change in variable X_i, the variables other than X_i being constant.

σ_{Xi} = the standard deviation in measured values of X_i.

The standard deviation of a quantity is a measure of the frequency with which a given value of error will occur in this case. Along with the most probable value, the standard deviation completely characterizes a normal distribution.

If it is established that for certain equipment the standard deviation in pressure measurement is 1 psi., from a very large number of measurements 50 per cent would fall within $\pm 0.675\ \sigma$ (0.675 psi.), of the correct value of the pressure, 68.3 per cent within 1 psi., 95.5 per cent within 2 psi., and 99.7 per cent within 3 psi.

Thus, when appropriate values have been selected for the standard deviation of each measured quantity, it is possible to estimate the frequency with which errors in efficiency of a given magnitude will occur under specified test conditions. For a flow equation of the form:

$$Q_b = KE\sqrt{\frac{P_1^2 - P_2^2 - (0.0375 G \Delta h\ P_{avg}^2)/zT}{GTLz}} \quad (3)$$

In this equation, $N = 0.375G\ \Delta h (P_1 + P_2)/zT$. This equation relates

the standard deviation in flow efficiency to the various quantities and their standard deviations.

The following example will illustrate the use of these equations. It is assumed that all the measurements in a certain pipeline-flow efficiency tests are carefully made so that the following estimates of standard deviations apply:

application of Equation 3 yields

$$\left(\frac{\sigma_E}{E}\right)^2 = \frac{\sigma_{Q_b}^2}{Q_b^2} + \frac{1}{4(\Delta P \cdot N)^2}\left[\sigma_{\Delta P}^2 + N^2\left\{\left(\frac{\sigma_G}{G}\right)^2 + \left(\frac{\sigma_z}{z}\right)^2 + \left(\frac{\sigma_T}{T}\right)^2 + \left(\frac{\sigma_{\Delta H}}{\Delta H}\right)^2\right\}\right]$$

$$+\frac{1}{2}\left(\frac{N}{\Delta P \cdot N}\right)\left[\left(\frac{\sigma_G}{G}\right)^2 - \left(\frac{\sigma_z}{z}\right)^2 - \left(\frac{\sigma_T}{T}\right)^2\right] + \frac{1}{4}\left[\left(\frac{\sigma_G}{G}\right)^2 + \left(\frac{\sigma_z}{z}\right)^2 + \left(\frac{\sigma_T}{T}\right)^2\right] \quad (4)$$

$\sigma_{Q_b}/Q_b = 0.0035$, $\sigma_G = 0.002$, $\sigma_T = 1°$ F, $\sigma_z = 0.0025$,

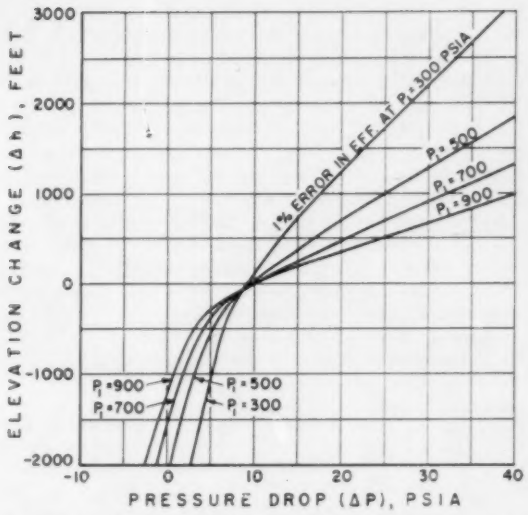
$\sigma_{\Delta h} = 1$ ft., $\sigma_{\Delta P} = 0.05$ psi.

The test measurements are as follows: $P_1 = 900$, $P_2 = 860$, $\Delta h = 150$, $z = 0.9000$, $T_{avg} = 520°$ R., and $G = 0.600$. With these values, Equation 4 gives $\sigma_E/E = \pm 0.0043$. Thus, the calculated flow efficiency should be good to ± 0.43 per cent about 68 times in 100, and within ± 0.86 per cent about 95 times in 100 determinations.

The specific values to be used for the standard deviations of the quantities involved in efficiency test work depend upon the equipment used and to some extent upon the skill of the test personnel. Actually they should be determined for a given situation by analysis of the performance of test personnel and instruments. It is more practical, however, to estimate standard deviations because so many variables are involved in efficiency testing and the effort necessary to determine actual values would be so great.

For the purpose of examining the conditions under which acceptable accuracy can be obtained in efficiency test work it is sufficient to choose reasonably accurate values for the standard deviations. Those given in the previous example represent values selected on the basis of field experience in field testing where deadweight gages were used for pressure measurement and orifice meters were used for flow-rate measurement.

They presume that considerable care is exercised in making the measurements and calculating average pressures and temperatures. These values were inserted into Equation 4 to prepare Fig. 1, which shows lines of constant 1 per cent error in flow efficiency for various operating conditions. Each line of constant operating pressure gives conditions for which $\sigma_E/E = 0.005$ so that for the standard deviations used, 95 per cent of all determinations of efficiency would fall within 1 per cent of correct value.



OPERATING CONDITIONS are shown giving 95.5 per cent certainty that error in flow efficiency is less than 1 per cent. Fig. 1.

Qualitatively, Fig. 1 shows that operating conditions to the right of each constant upstream pressure curve can be expected to give satisfactory results. For operating conditions to the left of the curve the probability of undesirably large error increases. For example, good accuracy is not likely for a pipeline section with a positive change in elevation where the pressure drop is less than 10 psi. It is also apparent that conditions of high-pressure operation are subject to greater restrictions than are low-pressure operation.

Where deadweight gages are not used for pressure measurement or where there is reason to believe that the individual measurements are not as good as those presumed in constructing Fig. 1, Equation 4 should be used to determine the accuracy to be expected in the final result.

Pressure Measurement

Errors in the measurement of pressure affect both $Q_{b,\,obs.}$ as determined by the ammonia-tracer method and $Q_{b,\,calc.}$. However, the effect of such errors on $Q_{b,\,calc.}$ is less apparent than in the case of $Q_{b,\,obs.}$ by ammonia tracer. The value of $Q_{b,\,obs.}$ by ammonia tracer is proportional to average pressure, as shown in the numerator of Equation 1. The average pressure is expressed accurately by the equation:

$$P_{avg} = \frac{\int P dL}{L} = \frac{2}{3}\left(\frac{P_1^3 - P_2^3}{P_1^2 - P_2^2}\right) = \frac{2}{3}\left[P_1 + \frac{P_2^2}{P_1 + P_2}\right] \quad (5)$$

Where P, in the integral, is a function of line length as determined by the general flow equation. Since pressures should be measured to the nearest 0.1 psi., and ordinarily both P_1 and P_2 are several hundred psi., the relative error, or error in P_1 divided by the pressure, will usually be negligible, and always less than the relative error in P_2. Thus, the pressure measurements will not ordinarily contribute appreciable error to the calculation of $Q_{b,\,obs.}$

The effect of errors in pressure measurement on $Q_{b,\,calc.}$ is determined by first making an estimate of the uncertainty in a single reading for a given pressure-measuring device properly calibrated. The magnitude of this uncertainty is set equal to σ_p. The corresponding uncertainty in $Q_{b,\,calc.}$, obtained by use of the principle of Equation 2, is given by:

$$\sigma_{Q_b} = \sqrt{\left(\frac{\partial Q_b}{\partial P_1}\right)^2 \sigma_{P_1}^2 + \left(\frac{\partial Q_b}{\partial P_2}\right)^2 \sigma_{P_2}^2} \quad (6)$$

The values of $\partial Q_b/\partial P_1$ and $\partial Q_b/\partial P_2$ are obtained from the following expression...

$$Q_{b,\,calc.} = K\sqrt{\frac{P_1^2 - P_2^2 - 0.0375\,G\,\Delta h\,P_{avg}^2}{zTLfG}} \quad (7)$$

on the assumption that P_{avg} is not affected significantly by the errors in pressure measurement, and:

$$\frac{\sigma_{Q_b}}{Q_b} = \frac{\sigma_P\sqrt{P_1^2 + P_2^2}}{(P_1^2 - P_2^2) - 0.0375\,G\,\Delta h P_{avg}^2/zT} \quad (8)$$

Equation 8 was used to prepare Fig. 2 which shows the operating conditions for which 95 per cent of all errors in Q_b would be less than 0.5

per cent. The calculation was carried out by assigning σ_{Q_b/Q_b} the value of 0.005, and determining values of pressure and Δh satisfying the equation for a relative error corresponding to 2σ units, i.e., 0.01 in one case and by assigning σ_{Q_b/Q_b} the value of 0.0025 in the other. Thus, the curves in Fig. 2 are lines of constant error corresponding to 2σ units in $Q_{b,\,calc.}$ so that operating conditions on or above each curve will yield errors almost certainly less than 1 per cent and 0.5 per cent respectively.

Another problem arising in respect to pressure measurement is the proper determination of average pressure. The more readily calculated arithmetic average:

$$P_{avg} = (P_1 + P_2)/2 \qquad (9)$$

is not as accurate as Equation 5, but its use results in negligible error under certain conditions. The percentage difference between the two average pressures may be expressed:

$$\text{Per cent Difference} = 25 - (75R)/(R^2 + R + 1) \qquad (10)$$

where:
$R = P_1/P_2$.

Table 1 shows the pressure ratios corresponding to various percentage differences.

TABLE 1 — DIFFERENCE BETWEEN P_{avg} (EQUATION 9) AND P_{avg} (EQUATION 10)

Per cent difference	$R = P_1/P_2$
—0.2	1.167
—0.4	1.250
—0.6	1.316
—0.8	1.375
—1.0	1.429

Since $Q_{b,\,obs.}$, determined by the ammonia - tracer method, is proportional to P_{avg}, the above table shows that only with unusually high-pressure drops in the ammonia-tracer section would errors larger than 1 per cent be incurred by use of Equation 4.

Average pressure affects $Q_{b,\,calc.}$ in a more complex way. With the substitution $P_1/P_2 = R$, the percentage difference between the values of $Q_{b,\,calc.}$ determined by the two expressions for P_{avg}, is given:

$$\text{Per cent difference} = 100 - 100\left[\frac{R^2 - 1 - \left(\frac{0.03756\,\Delta h}{zT}\right)\left(\frac{R+1}{2}\right)^2}{R^2 - 1 - \left(\frac{0.03756\,\Delta h}{zT}\right)\left(\frac{4}{9}\right)\left(\frac{R^2+R+1}{R+1}\right)^2}\right] \qquad (11)$$

Considerable care must be exercised in the use of this equation, because not all of its solutions correspond to physically possible conditions, with:

$R > 1$, and $\Delta h > 0$, then per cent difference < 0.
$R > 1$, and $\Delta h < 0$, then per cent difference > 0.
$R < 1$, and $\Delta h < 0$, then per cent difference > 0.
$R < 1$, and $\Delta h > 0$, is not physically possible.
$R < 0$ is not physically possible.

This equation was investigated by solving for Δh, as follows:

$$\Delta h = \frac{(R^2-1)(2D-D^2)\left(\frac{zT}{0.03756}\right)}{\left(\frac{R+1}{4}\right)^2 - \frac{4}{9}(1-D)^2\left(\frac{R^2+R+1}{R+1}\right)^2}, \text{ where } D = \frac{\text{Per cent difference}}{100} \qquad (12)$$

Only large pressure drops with very large negative elevation changes were found to involve significant errors in $Q_{b,\,calc.}$. Fig. 3 shows conditions giving lines of constant error in $Q_{b,\,calc.}$ incurred by the use of Equation 9.

With few exceptions, the arithmetic average is sufficiently accurate for pipeline efficiency test work.

Temperature Measurement

The temperature distribution along a pipeline depends upon the rate of heat transfer from pipe to soil, and upon the gas cooling which results from reduction in pressure. Because soil conditions may vary considerably along a pipeline, and the extent of cooling on expansion depends on gas composition, temperature, and pressure, it is not possible to use a simple general expression relating gas temperature to length in a pipeline.

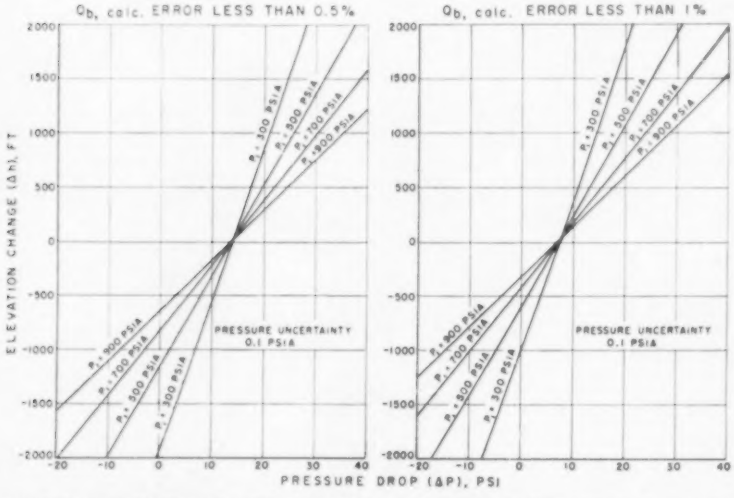
Therefore, where large temperature changes are found over a pipeline section, the most accurate method of determining average temperature is to obtain temperature measurements at intervals between the end points of the section tested, and obtain the value $T_{avg} = \int T\,dL/L$ by graphical integration, within the limits, O to L. This is very closely approximated by application of the trapzoidal rule, as was shown in Part 2 of this series.

For small temperature drops, however, the arithmetic average temperature will be sufficiently accurate. An index to the accuracy obtained by use of the arithmetic average may be obtained as follows. Temperatures along a pipeline are often approximately those given by the logarithmic distribution predicted by consideration of heat transfer from the pipe to a uniform soil so that an approximation for the average temperature may be written:

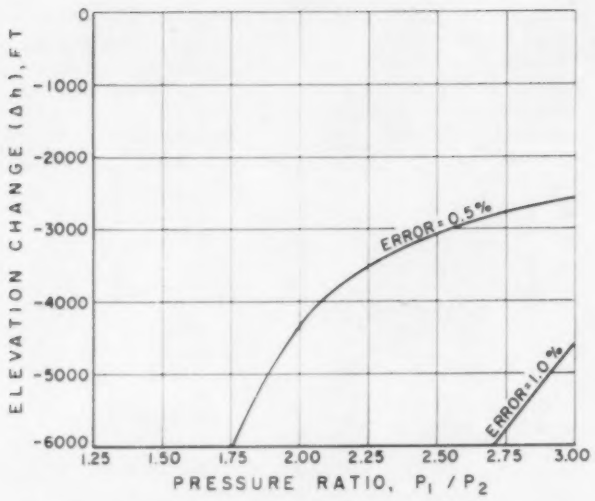
$$T_{avg} = T_g + \frac{(T_1 + T_2)}{2.303 \log (T_1 - T_g)/(T_2 - T_g)} \qquad (13)$$

where T_g is ground temperature, T_1 and T_2 are gas temperatures at the terminal points of the pipe section under test. Average temperatures were calculated by use of this equation for various values of T_1 and T_2 with T_g varying from 40° to 80° F., and compared with the arithmetic average. The results are summarized in Fig. 4.

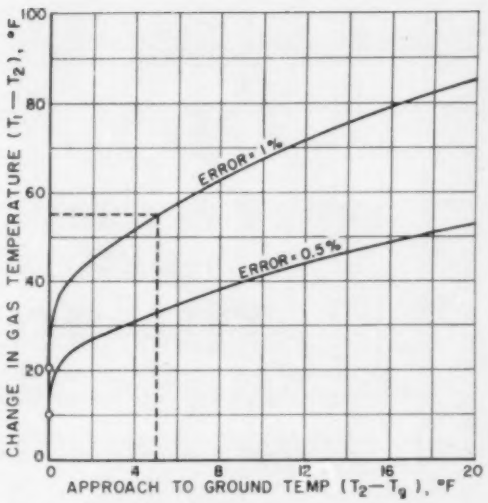
To use this figure it is necessary to estimate the difference between T_2 and T_g, but it will be observed that from


$Q_{b,\,calc.}$ ERROR LESS THAN 0.5%
$Q_{b,\,calc.}$ ERROR LESS THAN 1%
ELEVATION CHANGE (Δh), FT
PRESSURE DROP (ΔP), PSI
PRESSURE UNCERTAINTY 0.1 PSIA
P₁ = 300 PSIA
P₁ = 500 PSIA
P₁ = 700 PSIA
P₁ = 900 PSIA

OPERATING CONDITIONS listed give 95.5 per cent certainty that error in $Q_{b,\,calc.}$ will be less than 0.5 per cent or less than 1 per cent. Fig. 2.



OPERATING CONDITIONS giving 0.5 and 1 per cent error using $(P_1 + P_2)/2 = P_{avg}$ instead of $2(P_1^3 - P_2^3)/3(P_1^2 - P_2)$. Fig. 3.



RELATIVE ERROR is shown in $Q_{b,\ calc.}$ resulting from use of $(T_1 + T_2)/2$ as average temperature. Fig. 4.

gas temperature differences of less than 20° F., the arithmetic average will be sufficiently accurate. Where $T_1 = 120°$ F., $T_2 = 65°$ F., and $T_g = 60°$ F., the approach to ground temperature is $65 - 60 = 5$, and the change in gas temperature is $120 - 65 = 55$. For these conditions, the figure shows that an error of approximately 1 per cent in $Q_{b,\ calc.}$ will be incurred by the use of the arithmetic average. In this case it would be advisable to obtain temperature profile data since the arithmetic average involves significant error.

Errors in temperature measurement result in proportional errors in the value of $Q_{b,\ obs.}$ determined by ammonia tracer. Since absolute temperatures are involved, rather large errors in temperature are required to affect the value of $Q_{b,\ obs.}$ significantly. As shown, at 80° F., the error in $Q_{b,\ obs.}$ resulting from a 5° F. error in temperature measurement is:

$$([(540 \pm 5)/540] - 1) \times 100$$

$$= 0.8 \text{ per cent}$$

Since only small temperature drops are ordinarily experienced over tracer travel distances, the use of the arithmetic average temperature for calculating $Q_{b,\ obs.}$ usually involves much less than 0.5 per cent error when accurate temperature measurements are made.

In determining $Q_{b,\ calc.}$, temperature enters all equations to approximately the ½ power, and the effect of an error in temperature of a given magnitude is less than that for $Q_{b,\ obs.}$.

Specific Gravity

In all flow equations, specific gravity enters in the $Q_{b,\ calc.}$ to approximately the ½ power. Where gas or processing results in variations in gravity, determination of this quantity at the time of test can contribute significantly to test accuracy. The error involved in using an erroneous value G_e in place of the true value G_t can be estimated by:

$$[1 - (G_e/G_t)^{1/2}]\ 100$$

Thus, for $G_t = 0.650$, $G_e = 0.637$, the error in $Q_{b,\ calc.}$ will be 1 per cent if G_g is used. If the uncertainty in specific gravity is located beyond the second decimal place, the resultant uncertainty in $Q_{b,\ calc.}$ will be ordinarily less than 1 per cent.

Compressibility Factor

Both $Q_{b,\ obs.}$ and $Q_{b,\ calc.}$ require value for compressibility factor. Flow rates determined by tracer methods are proportional to z_{avg}, while flow rates determined by orifice meter, and $Q_{b,\ calc.}$ depend upon values of $(1/z)^{1/2}$. An error in z of 0.01 will result in approximately 1 per cent error in $Q_{b,\ obs.}$ by tracer method and ½ per cent error in $Q_{b,calc.}$. The excellent correlations of $(1/z)^{1/2}$ (the orifice meter factor F_{pv}) now available are quite adequate for efficiency test work.

Elevation Change

Elevation changes alter the distribution of pressures along a pipeline and enter into the determination of $Q_{b,\ calc.}$ as a correction on the value of $P_1^2 - P_2^2$. The effect of elevation change is significant where its value is large, and for relatively small values where the pressure drop is small.

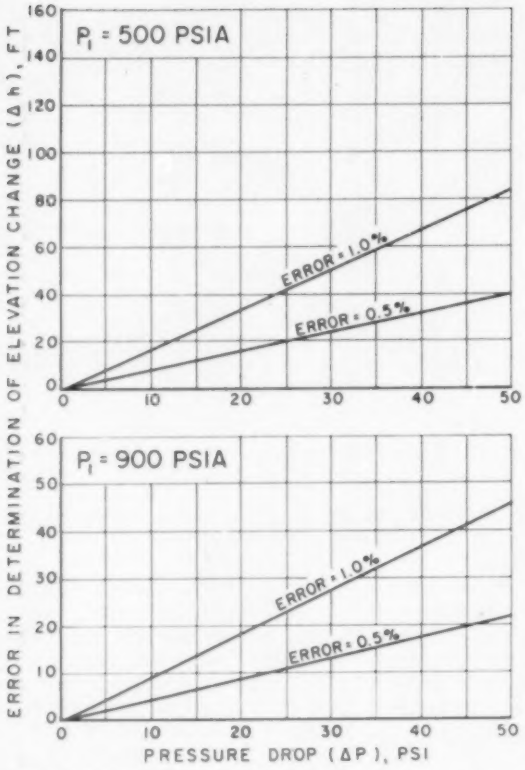
The effect of a given error in elevation change on $Q_{b,\ calc.}$ can be investigated as follows: let the error in elevation change be given by $(1 - \alpha)\ \Delta h$, where the true value is Δh, and the erroneous value is $\alpha\ \Delta h$. The percentage difference between the values of $Q_{b,\ calc.}$ as calculated with the two values of elevation change will be given:

$$\left(\frac{Q_{b1} - Q_{b2}}{Q_{b1}}\right)100 = 1 - \left[\frac{P_1^2 - P_2^2 - \dfrac{0.0375\ \Delta h\ P^2_{avg}}{z_{avg}\ T_{avg}}}{P_1^2 - P_2^2 - \dfrac{0.0375 \alpha\ \Delta h\ P^2_{avg}}{z_{avg}\ T_{avg}}}\right]^{1/2} \quad (14)$$

This equation is the basis for Fig. 5, which shows lines of constant 0.5 per cent and 1 per cent errors in $Q_{b,\ calc.}$ for various errors in elevation change determination and values of pressure drop. Fig. 5 may be used to determine whether a given elevation change will have a significant effect on the value of $Q_{b,\ calc.}$ and the degree of accuracy required in determining elevation changes.

For example, it is estimated that an elevation change of 50 ft. occurs over a pipeline section where $P_1 = 900$ psi., $P_2 = 850$, $G = 0.65$, $z_{avg} = 0.900$, and $T_{avg} = 540°$ R. On the graph for 900 psi., at 50-ft. error in elevation change and 50-psi. pressure drop, it is found that an error in excess of 1 per cent result if the elevation change is neglected. Under these conditions it will be necessary to estimate elevation changes within 23 ft. to keep the error in $Q_{b,\ calc.}$ less than 0.5 per cent.

The determination of $Q_{b,\ obs.}$ by orifice meter is affected by tolerances


P₁ = 500 PSIA
ERROR = 1.0%
ERROR = 0.5%
P₁ = 900 PSIA
ERROR = 1.0%
ERROR = 0.5%
ERROR IN DETERMINATION OF ELEVATION CHANGE (Δh), FT
PRESSURE DROP (ΔP), PSI

EFFECT OF ERROR in elevation change on $Q_{b,\ calc.}$ is shown here. Fig. 5.

in the coefficients (see pages 83, 93, and 94 of "Orifice Metering of Natural Gas," Gas Measurement Committee report No. 3, American Gas Association, April 1955). For orifices properly constructed and installed, the coefficients for flange taps are subject to a tolerance of ±0.5 per cent when an incompressible fluid is used, and the diameter ratio is between 0.15 and 0.70. For pipe taps the tolerance is ±0.75 per cent for diameter ratios between 0.20 and 0.67.

The authors do not presume to establish the magnitude of probable errors in the orifice metering of natural gases. But it appears prudent, in attempting to evaluate pipeline-efficiency test data, to assume an uncertainty in the determination of $Q_{b,\ obs.}$ somewhat larger than the tolerances listed in the report cited.

Combined Effect of Errors

In the preceding sections, the individual measurements were examined to find the effect of errors on $Q_{b,\ calc.}$ and $Q_{b,\ obs.}$. Given the probable variations in each of the measured quantities it is desirable to estimate the resultant variation in calculated flow efficiency. If these variations are normally distributed as has been assumed, the values of E will be normally distributed, and Equation 2 gives the standard deviation of this value.

Based on Equation 2, the following relationship for the variables and the standard deviations has been derived:

$$\frac{\sigma_E}{E} = \left\{ \frac{\sigma^2_{Q_{b,\ obs.}}}{Q_{b,\ calc.}} + \frac{1}{4(\Delta P \cdot N)^2}\left[\sigma_{\Delta P} + N^2\left\{\left(\frac{\sigma_G}{G}\right)^2 + \left(\frac{\sigma_z}{z}\right)^2 + \left(\frac{\sigma_T}{T}\right)^2 + \left(\frac{\sigma_{\Delta h}}{\Delta h}\right)^2\right\}\right] \right.$$

$$\left. + \frac{1}{2}\left(\frac{N}{\Delta P \cdot N}\right)\left[\left(\frac{\sigma_G}{G}\right)^2 - \left(\frac{\sigma_z}{z}\right)^2 - \left(\frac{\sigma_T}{T}\right)^2\right] + \frac{1}{4}\left[\left(\frac{\sigma_G}{G}\right)^2 + \left(\frac{\sigma_z}{z}\right)^2 + \left(\frac{\sigma_T}{T}\right)^2\right]\right\}^{1/2} \quad (15)$$

where $N = \dfrac{0.0375\ G\ \Delta h\ (P_1 + P_2)}{4\ z\ T}$

By means of this equation, the standard deviation in E can be found for given measurement conditions where the standard deviation in each variable can be estimated.

Where the recommendations cited earlier are followed, and accurate average temperatures and pressures are computed, the σ values listed earlier should be reasonably accurate.

Example 1 . . . With these values for standard deviation, and the following conditions of measurement, $P_1 = 900$, $P_2 = 860$, $\Delta h = 150$, $z = 0.9000$, $T_{avg} = 520°$ R., $G = 0.600$, the reliability of the value of the pipeline-flow efficiency can be determined. Thus:

$$N = \frac{0.0375\ G\ \Delta h\ (P_1 + P_2)}{4\ z\ T} = \frac{0.0375 \times 0.600 \times 150 \times 1760}{4 \times 0.9000 \times 520} = 3.17$$

$$\left(\frac{\sigma_G}{G}\right)^2 + \left(\frac{\sigma_z}{z}\right)^2 + \left(\frac{\sigma_T}{T}\right)^2 = \left(\frac{0.002}{0.600}\right)^2 + \left(\frac{0.0025}{0.9000}\right)^2 + \left(\frac{1}{520}\right)^2 = 22.5 \times 10^{-6}$$

$$\left(\frac{\sigma_G}{G}\right)^2 - \left(\frac{\sigma_z}{z}\right)^2 - \left(\frac{\sigma_T}{T}\right)^2 = \left[11.111 - 7.716 - 3.697\right] \times 10^{-6} = -0.3 \times 10^{-6}$$

$$\frac{\sigma_E}{E} = \left\{12.5 \times 10^{-6} + \frac{1}{4(40 - 3.17)^2}\left[2900 \times 10^{-6}(3.17)^2(22.5 \times 10^{-6}) + (3.17)^2/(950)^2\right]\right.$$

$$\left. + \frac{3.17}{2(40 - 3.17)}(0.3 \times 10^{-6}) + 22.5 \times 10^{-6}/4\right\}^{1/2} = 0.0043$$

Example 2 . . . Fig. 1 or 5 can also be used to obtain a first estimate of the reliability of efficiency test data. For example, the point corresponding to $P_1 = 900$, $\Delta P = 18$ psi., and $\Delta h = 750$ ft., is found to lie well above the curve for $P_1 = 900$ psia. For these conditions the probability is greater than 5 per cent that the value of efficiency found is not within 1 per cent of the most probable value.

Where the accuracy of the individual measurements is not as good as those used in the preparation of Fig. 1 or 5, the limiting curves move to the right, restricting the area of accurate measurement. In particular, where the uncertainty in elevation change or flow rate determination is large, Fig. 5 will not adequately represent the degree of accuracy obtainable.

Conclusions

The method which has been developed for estimating the accuracy of the measurements necessary for pipeline-flow efficiency calculations permits estimating the accuracy of the final result. It permits the test engineer to determine whether the methods of making measurements and the conditions proposed for a test will give a measured flow efficiency of sufficient accuracy. It permits the engineer to determine the measurements most likely to cause trouble so that he can take extra precautions in making them. It also permits the engineer to determine whether variations in measured efficiency are caused by random variations in measurement.

Acknowledgments

The recommendations given in these articles were developed by the Institute of Gas Technology as Project NB-13 under the sponsorship of the Pipeline Research Committee of the American Gas Association under the P.A.R. plan (Promotion-Advertising-Research). The Project Supervising Committee composed of H. L. Stowers, Texas Gas Transmission Corp., (chairman); D. C. Benson, Texas Gas Transmission Corp., (sponsor); T. H. Beals, Natural Gas Pipeline Co. of America; R. Galloway, Northern Natural Gas Co.; E. R. Griffith, American Gas Association; C. W. Marvin, Texas Eastern Transmission Corp.; C. C. McClure, El Paso Natural Gas Co.; J. M. Phillips, Southern Natural Gas Co.; C. E. Schorre, Transcontinental Gas Pipe Line Corp.; J. N. White, Panhandle Eastern Pipeline Co., was instrumental in the development of the recommended test procedures.

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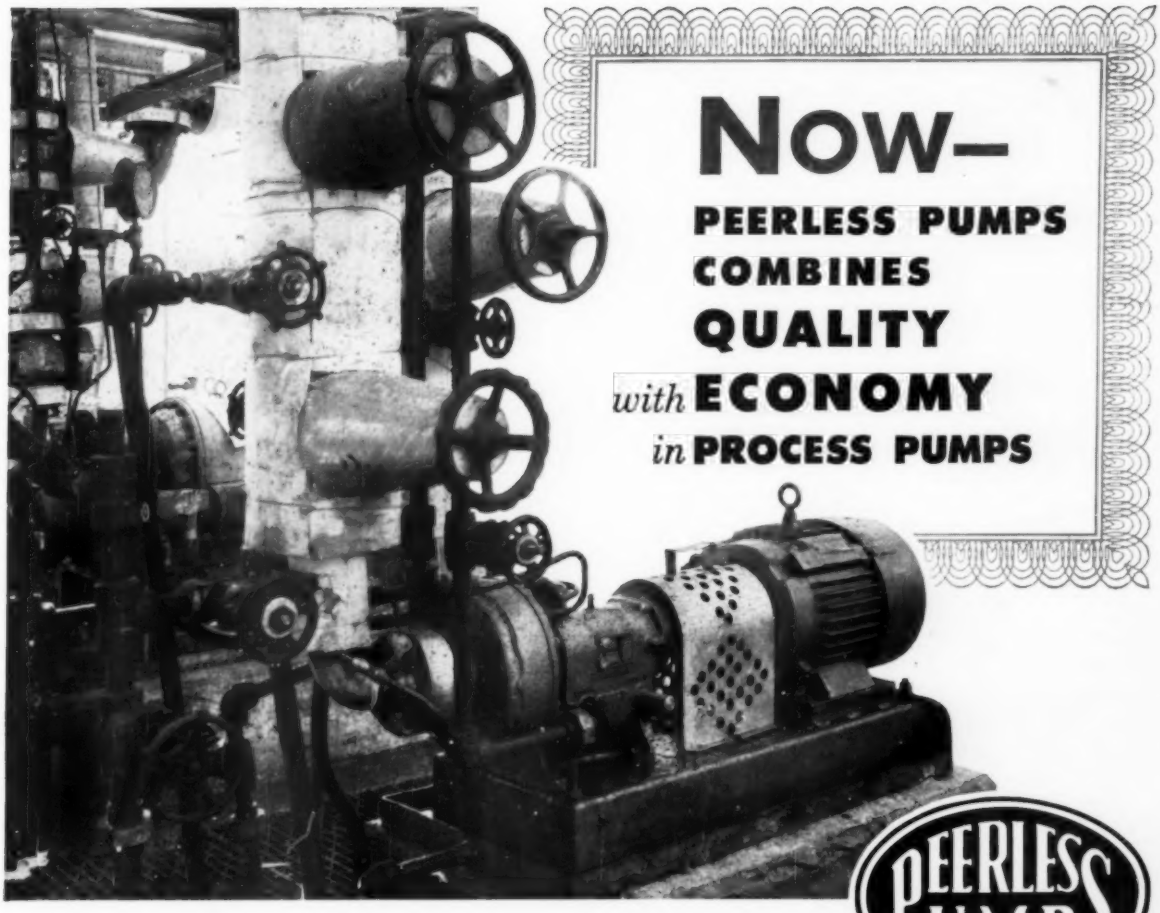

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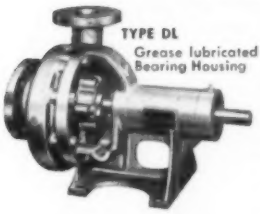
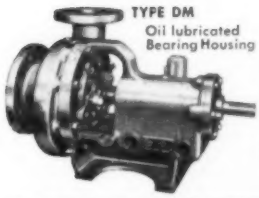


TYPE DL
Grease lubricated Bearing Housing



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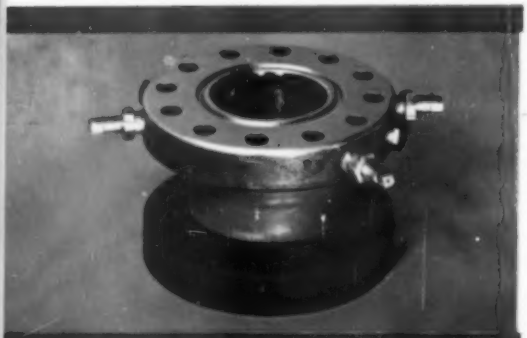
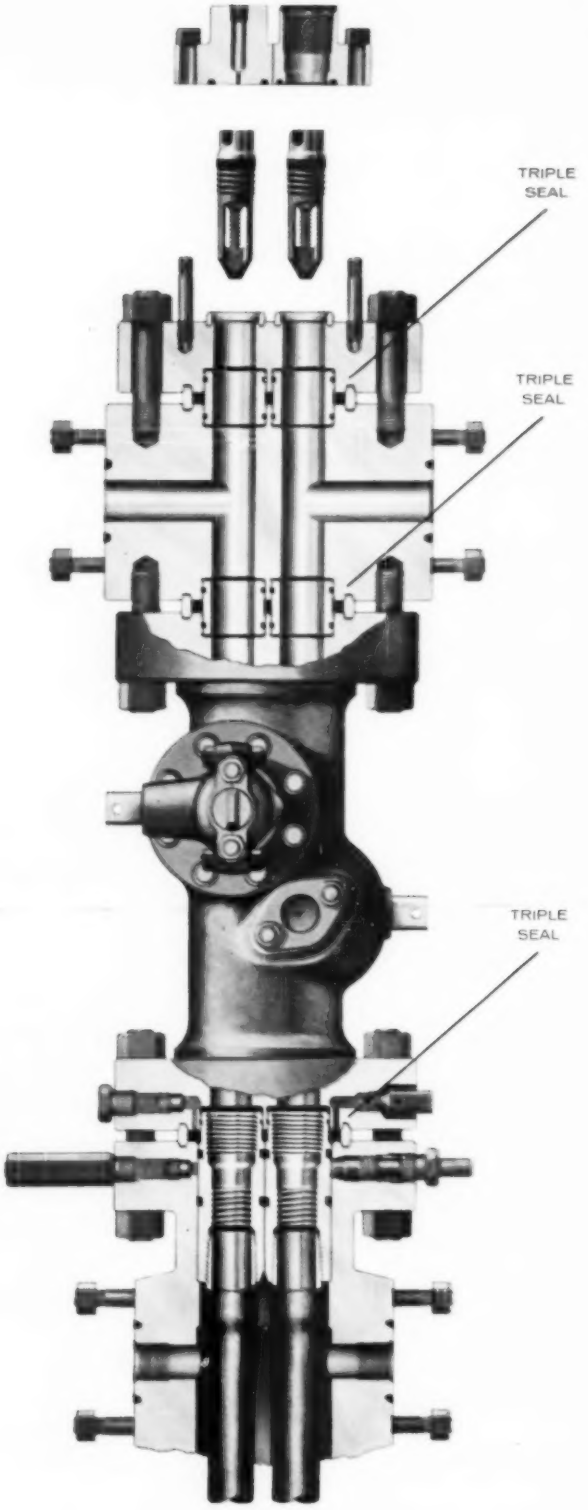


1. Standard API tubing head spools will receive this short "DC-B" hanger spool to convert an existing well to dual completion. All spools are Cameron forged steel.

2. "DC-B" tubing head spool with side outlets. Notice the plastic injection guns and hold-down screws which securely lock hangers in tubing head before blowout preventers are removed.

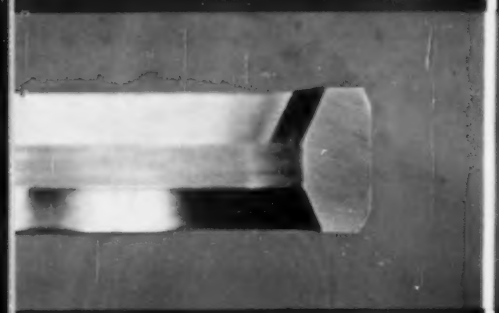


The famous Cameron Closed-Pressure completion method makes Cameron multiple completions the safest in the industry. Cameron patented back pressure valves are installed and removed mechanically by use of polished rods.

3. The Cameron "TC" triple completion spool provides all of the same features as the "DC-B" dual spools — tubing strings may be run independently or together for any bottom hole operation.

4. "DC-B" and "TC" Hangers locate automatically — may be run or pulled together or separately. They support full tubing joint strength — annulus pressures to full working pressure of tubing head.

5. Rugged oil resistant rubber seals are backed by steel rings on hanger necks and subs — are energized by injected plastic packing on annulus seals and circular pad.

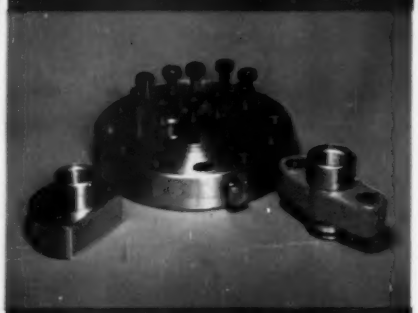


6. Cameron Self-Sealing Ring Gasket shown in section eliminates the headaches and hazards of old style API rings. With rubber seals it forms a triple safeguard against leaks.

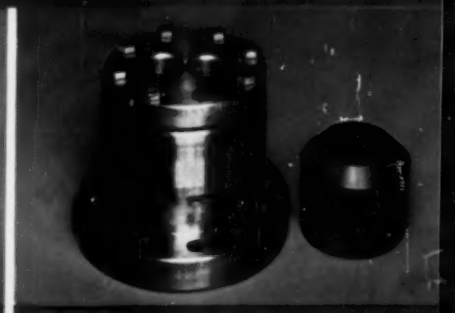
7. Cameron back pressure valves are the same size as the run of the tree. A 2" back pressure valve may be pulled through a 2" master valve making possible the famous Cameron Closed-Pressure completion.

8. Cameron dual bore Lift Plug master valve — easy operating — requires no lubricant for a perfect seal. Plug and seat can be replaced without removing valve from tree.

9. Forged steel dual bore tee with studded side outlets. Dual tee, seal flange and crown valve are all available with plastic injection ports or test ports optional in bottom flange.

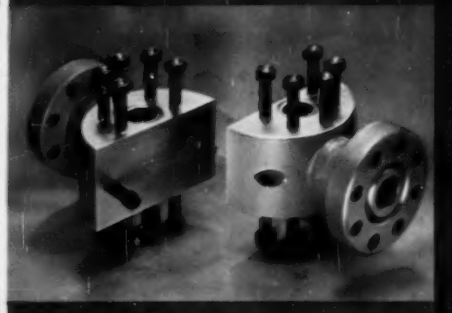


10. Seal flange adapts from dual bore tee to individual caps. Permits optional installation of crown valve — triple sealed for safety.



11. Dual "QD" slip and seal assembly for low pressure flowing wells or pumpers. Dual "RFA" wrap-around tubing hanger is designed for use in Type "F" tubing head spool with a short "DC-B" hanger spool above.

12. Single tubing hanger for converting dual to single completion. "DC-FBB" bell weevil for threaded suspension. Wrap-around "RFC" allows full joint manipulation, keeps high bottom hole pressures out of the annulus.



13. This dual Split-Tee affords an economical solution for higher working pressures (to 5,000 psi) with independent master valves and flanged connections.

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How close are we to

Commercial Liquefaction of Natural Gas?

Here's a look at some of the economic factors involved, particularly costs of storage and transportation

By Peter B. Lederman and Brymer Williams

LIQUEFACTION of natural gas at or near its source for transportation to fuel-poor areas is one of the most promising methods to be developed in recent years for the utilization of additional gas.

The major sources of natural gas are the Gulf Coastal area of the United States, the Persian Gulf area, and Venezuela, with minor fields in Italy, France, Pakistan, and several other countries. Only the United States has developed its natural-gas resources to any great extent for fuel purposes, with pipelines as the means of moving the fuel to markets.

Because of large overwater distances, movement by pipeline is impractical or virtually impossible if natural gas is to be supplied to the fuel-poor areas of the world from the fields where it is presently vented or returned to the reservoir.

Liquefaction with its inherent advantage of reduction to one six-hundredth in volume per heating unit appears to be a good method of processing the natural gas for movement over water, and in some cases might be competitive with pipelines in moving overland.

Cost breakdown . . . In examining the economics of the liquefaction process for transporting, storing, and supplying gas, the costs can be broken down into three major categories: liquefaction, transportation, and storage. The cost of liquefaction is chiefly dependent upon the compressor requirements, while the latter two are functions of distance from source to market and the efficiency with which both tankers and land storage are utilized.

In order to get a proper economic perspective, it will, therefore, be necessary to examine various liquefaction capacities and typical refrigeration cycles in addition to the various factors which influence shipping and storage costs.

There have been many types of cycle studied for liquefaction processes,[29] and their suitability varies with temperature level and equipment available. As can be seen from bubble-point plots such as Figs. 1 and 2 the liquefaction temperature is a function of the natural-gas composition and its pressure. The presence of ethane and heavier components will allow liquefaction at higher temperatures than is possible with pure methane, while helium or nitrogen in the gas will have the opposite effect.

It appears, also, that for most natural gases, ethylene in the cascade must be used as a refrigerant if vacuum is to be avoided at compressor suctions. In order to produce liquid for storage at atmospheric pressure, with the accompanying temperatures in the neighborhood of —260° F., autorefrigeration will be necessary.

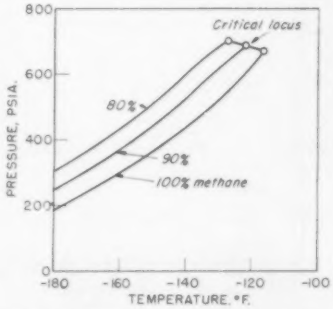
At the present time, it appears that the most economical cycle available is the propane-ethylene-methane (natural gas) cascade cycle. There may be situations where other cycles prove to be more economical and it will be necessary to examine each case individually.

Cycle choice . . . The choice of a cycle and the necessary power required for liquefaction depend on the particular properties of the gas being processed. It is beyond the scope of this paper to study the effect of cycle variation on the over-all economics.

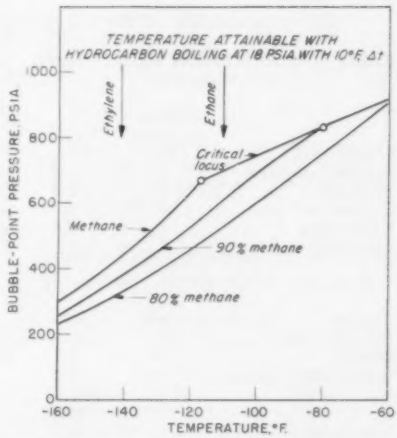
As a basis of design, a propane-ethylene-methane cycle will be utilized, as shown in the simplified flow diagram, Fig. 3 All the power requirements will be based on liquefying pure methane available at 800 psi. with a 75 per cent adiabatic compressor efficiency and a 10° F. temperature approach in the exchangers.

Fig. 3 also shows a version of the Claude cycle in which an expansion engine is used to reach low temperatures. This scheme is potentially as good as or better than the cascade system for some gases, but its eco-

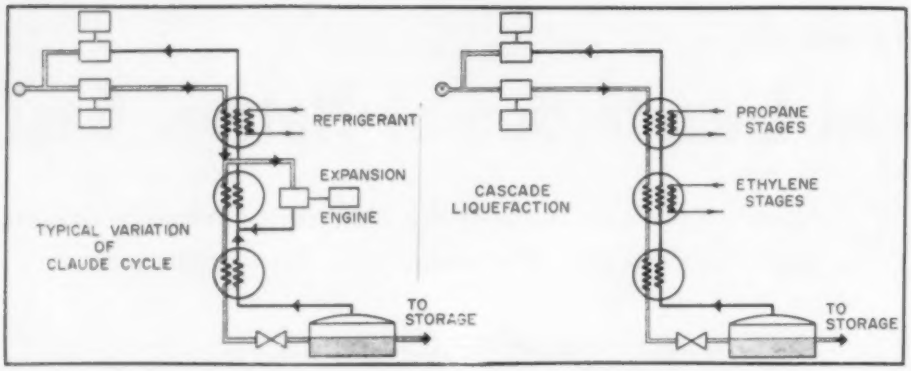
Authors are with department of chemical and metallurgical engineering, University of Michigan, Ann Arbor. Paper presented at annual meeting National Gasoline Association of America, Houston, 1957.



BUBBLE POINTS of methane-hydrogen mixtures. Fig. 1.



BUBBLE POINTS of methane-ethane mixtures. Fig. 2.



LIQUEFACTION CYCLES for the processing of natural gas. Fig. 3.

nomic feasibility is dependent upon the development of an expander which can handle gas-liquid mixtures with considerable quality.

Liquefaction Plant Economics

Based on a calculated power requirement of 0.51 hp. per M.c.f.d. of gas as liquefied product and the standard methods of pretreatment, three plants with capacities of 100, 250, 400 M.M.c.f.d. were estimated, with total costs indicated in Fig. 4. The costs, Table 1, include a 30 per cent increase for construction overseas. The major cost item in the plant is in the compressors and because of this the plant investment per unit of capacity will be quite stable, Fig. 5.

Since land and utilities and other items can vary widely depending on the particular location and gas composition, an average value was used in all cases. It would appear that due to the large investment in compression equipment, it would be wise to concentrate on methods of reducing power requirements. However, due to the other large capital items, a saving of 10 per cent in power requirements will only reflect an over-all saving of about 4 per cent.

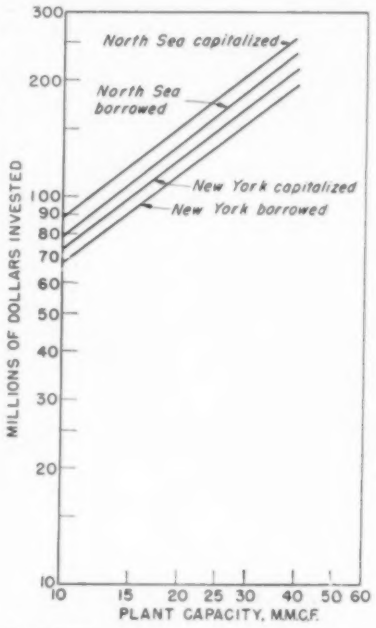
A close examination of the manufacturing costs, Table 2, reveals that the overriding item is depreciation which accounts for about 40 to 50 per cent of the cost depending on the cost of the raw material. Since another one-fourth of the total liquefaction cost is attributable to other fixed and relatively stable costs, the plant must operate with a high load factor to keep the unit cost within reason. The cost of liquefaction which is approximately $0.14 per M.c.f. liquefied for the specified condition is, therefore, relatively insensitive to plant capacities.

TABLE 1—FIXED PLANT INVESTMENT
(400 M.M.c.f.d.)

	Millions of dollars		Per cent
Compressors	65		27
Process equipment	7		3
Buildings	7		3
Utilities and land	9		4
Engineering	6		2.5
Contractor	5		2
Plant cost	99	99	(41.5)
Tankers	79		33
Storage tanks	31		13
Docks	4		1.7
Regasification plant	4		1.7
	118	118	(49.5)
Contingency		22	9
Total		$239	(100)

Storage and Transportation

The investment in storage and shipping facilities, including a regasification plant, will amount to a little over half of the total capital required (Table 1). Efficient use of both the tankers and storage equipment, as well as efficient design, will be necessary so that the whole operation will be economically feasible.



CONTROL COSTS of gas liquefaction points. Fig. 4.

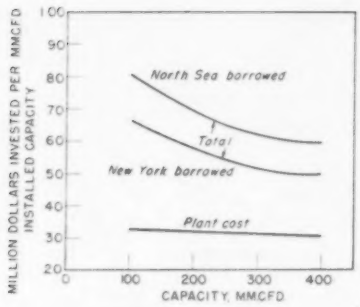
In order to obtain the cost of transportation and storage, combinations of sources and markets in several areas were studied as shown in Table 3. The cost and investment will vary with tanker size and speed, as well as the distance from source to market. In a recent comprehensive study by H. A. Benfore[21] of tanker economics, as indicated in Fig. 6, it is shown that the optimum tanker speed in most situations will be about 16 knots and this speed was used.

In order to evaluate the effect of tanker size, ships with capacities of 700, 900, 1,100, and 1,400 M.M.c.f. were considered. The optimum combination of ships and storage tanks was arrived at on the basis of lowest shipping and storage costs. In this phase the amount of capital required again plays a very significant part in determining the operating cost, since depreciation accounts for about 40 per cent of the shipping and storage

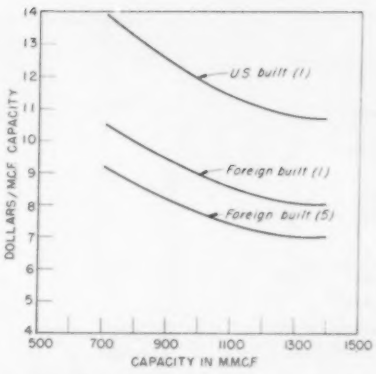
TABLE 2—PLANT OPERATING COSTS
(400 M.M.c.f.d.)

	$×10³	Per cent
Raw material (4 cents per M.c.f.)	4,200	18.4
Labor (incl. supervision)	600	2.6
Maintenance*	1,300	5.6
Power (gas) (4 cents per M.c.f.)	80	0.3
Other utilities	15	0.1
Direct manufacturing costs	$6,195	(27)
Pay roll and plant overhead	710	3
Depreciation (10 years' amortization)	12,000	53
Insurance	1,200	5
Administration, sales, and research	2,600	11
	$22,705	

*Basis, $5.00 per hp. installed for compression equipment plus $1.20 per hp. installed for general maintenance.



INVESTED CAPITAL as a function of unit capacity. Fig. 5.



RELATIVE TANKER COSTS as a function of capacity. Fig. 7.

costs, based on a 20-year amortization.

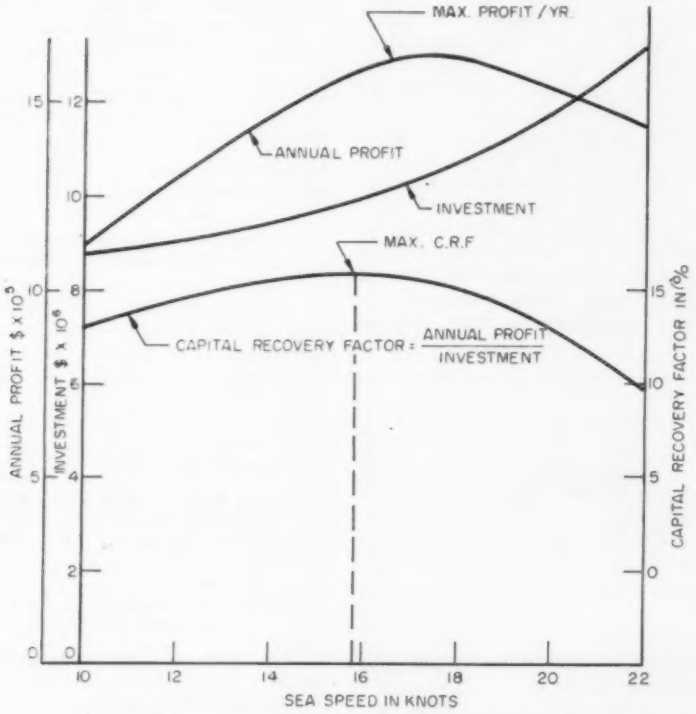
The investment required is based on building at least five tankers of the same design in foreign shipyards and a cost of $10 per M.c.f. of land storage. At the present time, this cost may be low since foreign yards have a backlog of tanker orders which should carry them over the next several years, and it may be necessary to build in the United States with its higher construction costs, Fig. 7.

Lowest cost . . . The lowest possible shipping cost will be achieved by keeping the large tankers at sea as much of the time as possible, since under American registry the crews' rates are fairly constant regardless of the tanker capacity and represent a major portion of the tanker operating cost, Table 4. There is very little reduction in the cost of operating the tankers should they be partially idle, or partially full and a high load factor, just as is necessary in pipeline operation, will be necessary in order to provide economical transportation of the product.

It is quite obvious that the distance from source to market will be a significant factor in the final delivered cost of the product as well as the total investment required to deliver a given amount a year. Table 5 lists the average number of trips that tankers with speed of 16 knots can complete annually. It will, therefore, take twice as many tankers to service the North Sea area from Venezuela or the United States as it will the New York area.

Similar analogies can be drawn for any combination of source and market, as indicated in Table 6 which indicates the relative costs of shipping a unit of product between various points. In addition to the shipping costs as such, there will be a corresponding increase in the investment required in tankers, since the effective yearly capacity of each tanker is inversely proportional to the number of trips completed.

Unless there is an overriding price differential either in raw-material costs, as will be the case when Venezuela and the Gulf Coast are considered as sources of supply, or selling price, as may be the case when competitive pricing in different areas such as New York or Great Britain takes



OPTIMUM TANKER SPEED for transporting liquefied gas. Fig. 6.

TABLE 3—SOURCE AND MARKET POSSIBILITIES STUDIED

Source—	Market	Distance*
Gulf Coast	New York	1,900
Gulf Coast	North Sea	2,500
Venezuela	New York	1,800
Venezuela	North Sea	2,100
Persian Gulf via Suez	New York	9,000
Persian Gulf via Suez	North Sea	6,500
Persian Gulf via Cape	New York	11,000
Persian Gulf via Cape	North Sea	11,600

*Nautical miles.

TABLE 4—TANKER OPERATING COSTS

(Venezuela to New York or Great Britain)
(1,400 M.M.c.f. capacity)

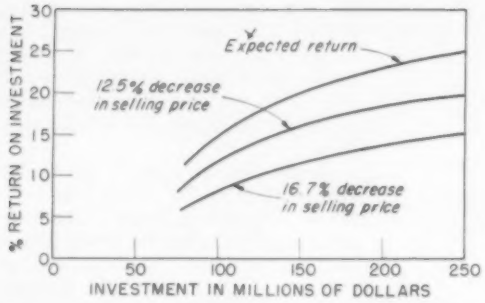
		Per cent
Crews' wages	$388,000	47
Overhead (incl. insurance)†	64,000	7
Stores and subsistence	60,000	8
Maintenance†	152,000	18
Fuel* (at 17 cents per M.c.f.)	166,000	20
Total	$830,000	

*Cost of fuel for ships operating from Gulf Coast is $330,000. Cost of fuel for ships operating via Suez is $276,000. †Method of Benford.[21]

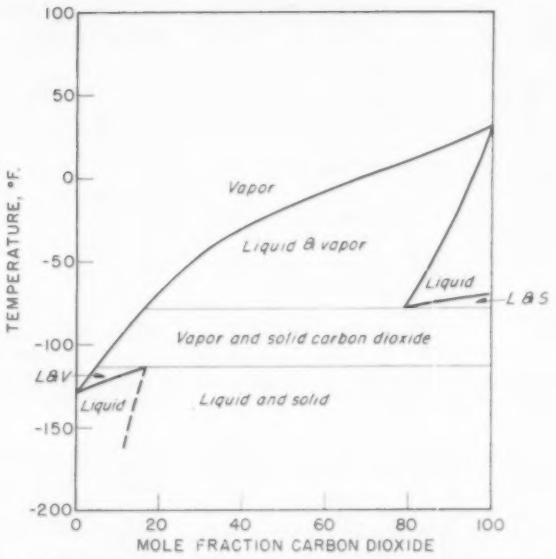
TABLE 5—NUMBER OF TANKER TRIPS PER YEAR

(Tanker speed, 16 knots)

	To— New York	To— North Sea
From—		
Venezuela	28	13
Gulf Coast	28	11
Persian Gulf (via Suez)	6.3	8.3
Persian Gulf (via Cape)	4.6	5.1


% RETURN ON INVESTMENT
INVESTMENT IN MILLIONS OF DOLLARS
Expected return
12.5% decrease in selling price
16.7% decrease in selling price

RETURN ON INVESTMENT based on percentage of investment and on hypothetical raw material costs $0.04 per M.c.f. Fig. 8.



CARBON DIOXIDE-METHANE in system at 500 psia. Fig. 10.

effect, it is important to operate in markets as close to the source of supply as possible.

Fuel charge . . . The charge made for fuel to the ships may have some effect on economics. The use of some natural gas as a fuel seems indicated, since some of the cargo will be vaporized during the trip, and unless used as fuel or reliquefied on board will be lost. The fuel, in the present case, was charged at the cost of liquefaction plus raw-material charges. It may be more advantageous under certain circumstances to reliquefy the gas and to use residual fuel oil instead.

For example, if the tanks are emptied and allowed to warm on the return voyage there will be a loss of liquid in the cooling process and, in addition it will be necessary to safeguard against excessive thermal shock. It appears wise to leave sufficient liquid in the tanks to maintain low temperature and utilize the evaporated gas for fuel to supplement or replace fuel oil. This will depend on the particular situation and bears further study.

In the study all estimates were based on liquefaction of all of the product at one installation and delivery to only one point. It may be desirable to deliver to several points, thereby eliminating some of the risk involved in basing the operation on a single market. In such a case, delivery costs will probably increase by between 5 and 10 per cent per added delivery point depending on the particular situation.

The Competitive Situation

The cost of liquefying and delivering natural gas to the point of consumption on a continuous basis will vary with plant capacity to a small degree and with distance to market to a larger degree. The largest plant liquefies 400 M.M.c.f.d. of gas. Using the most economic combination of tankers and storage, within the limits studied, the cost of processing will be $0.21 and $0.26 per M.c.f. respectively, according to Case Studies I and II.

This includes liquefying and delivering the natural gas from either the Gulf Coast of the United States or Venezuela to the New York area or Great Britain. These prices are exclusive of interest or taxes. Interest charges, should the capital be borrowed at the rate of 4 per cent, will be about $0.06 per M.c.f.

At the present time it would appear that liquid natural gas is competitive as a means of supplying fuel in the North Sea area and in all probability in the northeastern United States, Table 7. This assumes a source of natural gas can be found where the cost of the raw material is cheap.

TABLE 6—RELATIVE COST OF TANKER OPERATION PER UNIT DELIVERED

From—	To— New York	To— North Sea
Venezuela	1	2.2
Gulf Coast	1.2	2.8
Persian Gulf (via Suez)	5.9	4.3
Persian Gulf (via Cape)	7.0	6.2

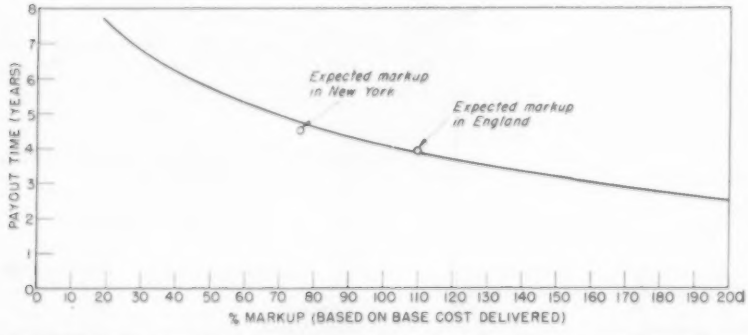
TABLE 7—COST OF FUELS
(Cost per equivalent M.c.f.)

	Great Britain	New York
Coal	$0.50	$0.40
Fuel oil	1.10	0.875
Natural gas		0.60
Manufactured gas	1.00	
Atomic energy (present est.)	3.60	
Atomic energy (1960 est.)	1.10	1.20
Atomic energy (1970 est.)	0.80	0.75

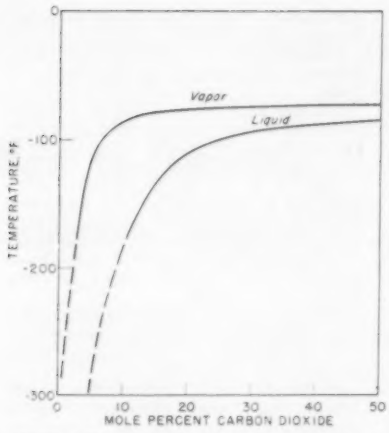
Sources: Wall Street Journal; A.G.A.; Battelle Technical Review, July 1956; Nucleonics, May 1956; United Nation Statistical Yearbook, 1955.

TABLE 8—APPROXIMATE PEAK LOAD SHAVING COSTS

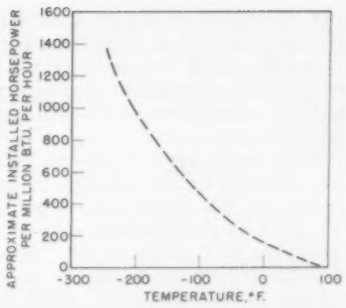
	Cost per M.c.f.
Oil gas	$0.80-$1.00
Liquid natural gas	$1.20
Propane[23]	$1.50
Demand pipeline gas[23]	as high as $4.80



PAYOUT TIME as a function of markup based on percentage of investment and on hypothetical raw material costs $0.04 per M.c.f. Fig. 9.



COMPOSITION OF PHASES in equilibrium with solid carbon dioxide. Fig. 11.



POWER REQUIRED to reach and provide refrigeration at given temperature. Fig. 12.

CASE STUDY I

East Coast Delivery—100 Per Cent Load Factor
(400 M.M.c.f.d. demand)

Processing cost, per M.c.f.	$0.13	
Transportation and storage	0.08	
Incremental cost	$0.21	
Raw-material cost	$0.04	0.25
Delivered cost	$0.25	0.46
Expected selling price	$0.60	
Investment required	$220,000,000	

CASE STUDY II

Great Britain Delivery—100 Per Cent Load Factor
(400 M.M.c.f.d. demand)

Processing cost, per M.c.f.	$0.13	
Transportation, per M.c.f.	0.13	
Incremental cost	$0.26	
Raw-material cost	$0.04	0.25
Delivered cost	$0.30	0.51
Expected selling price	$0.80	
Investment required	$240,000,000	

CASE STUDY III

Peak Load Shaving

Total annual peak-load duty, M.M.c.f.		3,600
Maximum monthly demand, M.M.c.f.		1,200
Storage required, M.M.c.f.		1,200
Annual requirement (to cover heat losses), M.M.c.f.		6,200
Investment:		
Storage at market at $10 per M.c.f.		$12,000,000
Allocated storage at plant		6,000,000
Total (not incl. shipping)		$18,000,000
Depreciation (at 5 per cent)	$900,000	
Operating expenses (tankers)	500,000	
Other operating expenses	1,500,000	
Subtotal	$2,900,000	$2,900,000
Cost of liquid gas f.o.b. plant at $0.17 per M.c.f. (6,200 M.M.c.f.)*		$1,050,000
Gross cost		$3,950,000
Credit for losses to line at $0.40 per M.c.f.		$1,000,000
Net cost		$2,950,000

Unit cost (not in profit) $0.85 per M.c.f.

*Based on raw material charge of $0.04 per M.c.f.

The maximum profitability is obtained by the largest investment studied, a 400-M.M.c.f.d. plant shipping to Europe. With an estimated competitive price of $0.80 per M.c.f. a payout time of about 3 years can be expected based upon the extremely low, perhaps unrealistic, price for raw material of $0.04 per M.c.f.

Payout variation . . . This payout period will be altered significantly with either a decrease in selling price or an increase in raw-material cost. Should the raw-material cost $0.20 per M.c.f., for example, the payout time would be about 3.6 years. If the capital required to build the facilities is borrowed instead of being raised through an issue of stock, the interest charges would have marked effect on the profitability.

In order better to evaluate the profitability of various investments, Figs. 8 and 9 show the payout period and return on investment for the various possibilities studied at a raw-material cost of $0.04 per M.c.f. The raw-material cost of $0.04 per M.c.f. was chosen as the cost of obtaining vented gas in the vicinity of the liquefaction plant and for which no market exists.

It is not inconceivable that the costs of exploration, development, and collecting gas, if properly recognized, might be as high as $0.50 per M.c.f. in the near future in some areas. Such costs would, naturally, be repeated in the final delivered cost of liquid and where possible in pipeline delivered cost.

Peak-load shaving . . . At the present time peak-load shaving is a problem faced by practically all utilities and it has been hoped that liquefied natural gas could alleviate this problem, as it did in its first application in Cleveland in the early 1940's. Peak-load shaving with natural-gas liquid appears to be an attractive possibility if the liquefaction plant and tankers can be kept operating at or near 100 per cent of capacity the year around.

The cost of the natural gas, as indicated in Case Study III, to take care of a 3,600-M.M.c.f. annual peak-load duty is about $1.20 per M.c.f. This clearly indicates the effect of not having a high turnover of stored liquid and it will therefore be necessary to treat each case separately.

The price quoted compares favorably with most other methods of peak-load shaving, Table 8, in use today. Unfortunately there is a strong indication that plants of the capacities discussed cannot expect to operate at full capacity on peak-load demands and must depend on a large percentage of their production being utilized in continuous load applications.

Technological Gaps

In order to achieve further savings through more efficient design there is a definite need for more technical data and improved and cheaper materials of construction. There is a very definite need for better thermal data for natural gas and its constituents at elevated pressures and low temperatures. These data should include specific heat data in general. But specific heat data in the high-pressure region near the critical point of the Molier diagrams and heats of solution are especially important.

Although good correlations of vapor-liquid equilibrium ratios are available, it is still necessary to obtain specific phase behavior if operation near the critical point is anticipated. Research programs now in progress will soon present data to help in closer design of expansion valves and heat exchangers. There is some question as to the allowable limit of carbon dioxide in the gas at liquefaction temperatures. Donnelly's data, Figs.

10 and 11, indicate that amine scrubbing will be sufficient,[8] but further data would be helpful in this area to check the extended curves presently used.

Carbon dioxide is not the only compound which may cause difficulty at extremely low temperatures. There is some evidence that the lighter paraffins are soluble in methane, but there is great doubt as to the behavior of the aromatics and hydrogen sulfide at liquefaction temperatures.

It appears that aromatics are relatively insoluble at storage temperatures and may have to be removed as condensate earlier. It will be necessary, especially when considering the richer Middle Eastern gases, to obtain data on the phase behavior of the lighter aromatics at elevated pressures and low temperatures with respect to natural gas or methane.

Better design of ships and storage units will not depend so much on improved physical data, or improved data on the low-temperature characteristics of metals, where information is quite adequate. It will depend on finding materials which will act both as insulators and liquid barriers and satisfy the demands of the rigid safety standards necessary at sea and in the storage areas.

At the present time it appears that alloy-steel tanks surrounded by insulation will be necessary to contain the liquid during shipment. A vessel with only insulation and no second tank would not only be cheaper but would have a greater capacity in all probability. Permanent storage facilities will also be cheaper if better insulating materials can be found that will eliminate the extensive use of alloy steel. There is room for improvement in design to achieve savings, but this will only be possible with additional technical data and better materials of construction.

Enhancing Profitability

Since it appears rather difficult to decrease production and delivery costs, it may be wise to invest in equipment to enhance the value of the product. At present there is a demand for ethane, propane, and butane at premium prices for use as chemical raw material and fuel. Once the gas has been liquefied, it is comparatively easy to separate the various components by standard fractionating techniques at a small additional cost.

In addition, nitrogen can be readily removed by this method, allowing a fuel of the highest possible heating value to be shipped. It may be profitable to carry this one step further and liquefy selective fractions at various temperatures before liquefying the major portion at —260° F., since it requires much less power, Fig. 12, to deliver refrigeration at temperatures not quite as low as those required for total liquefaction.

It has been suggested several times that recovery of the available refrigeration in the liquid natural gas at the point of regasification would enhance the profitability of this type of venture. Credit attainable from refrigeration recovery is very much dependent on the particular area where the regasification takes place, and although it definitely is worth investigation, it should not become the criterion for going ahead or stopping a venture of this type.

Conclusion

There is a definite need for additional fuel in certain areas of the world today and this demand appears to be steadily climbing. Atomic energy will no doubt carry part of this load, but there is more than enough room for the development of liquefied gas production. It appears that the liquefaction of natural gas for transportation and storage is economically feasible and should be competitive with most sources of fuel, including atomic energy, for some time to come.

The basic technological know-how is available and most of the improvements will enhance the over-all profitability only slightly. The choice of supply and market is critical in the economic picture, both with respect to shipping distance and price structure since shipping and raw-material costs are the critical variables in the process.

There is no doubt that gas liquefaction bears careful study as a profitable venture to use fuel presently vented or returned to the ground.

Acknowledgment

The advice of Prof. Harry Benford, of University of Michigan, department of naval architecture and marine engineering, in discussing tanker design is appreciated.

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How to Eliminate Pressure Surge

LARGE PRESSURE surges are sometimes created by the rapid action of control valves.

Boat, truck, and tank-car-loading facilities are examples of this type of installation, as well as fast acting valves in processing and can filling operations. This type of surge is created when the flow rate is rapidly altered with resulting pressure surges reaching many times the normal operating pressure of the system.

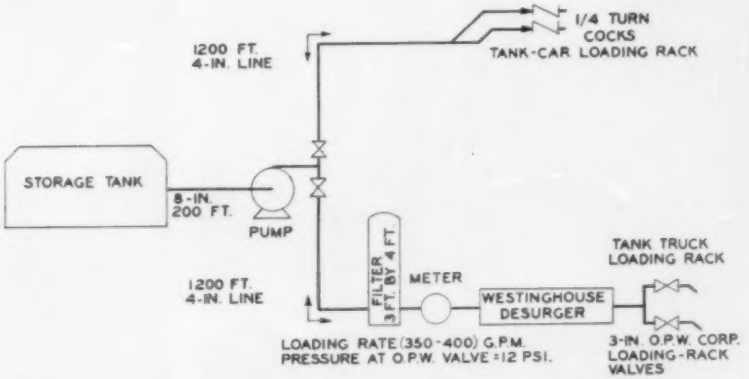
Pressure increase . . . A good rule of thumb to use in estimating the pressure increase caused by valve closure is to set ΔP (increase in pressure) equal to approximately 60 times the velocity before valve closure. That is $\Delta P = 60V$.

Fig. 1 is a line drawing of an actual, typical gasoline-truck loading installation in the Houston, Tex., area. This system consists of 200 ft. of 8-in. line plus 1,200 ft. of 4-in. line connecting storage tank with truck-loading rack. The normal loading rate is approximately 400 g.p.m. or 10 ft. per second.

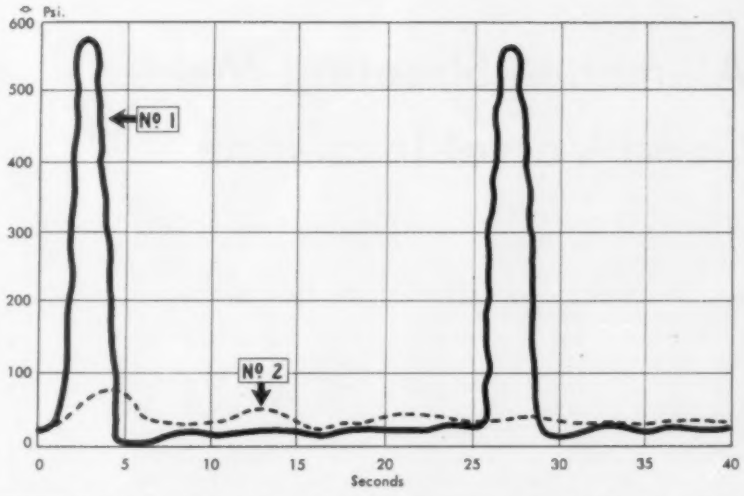
Fig. 2, curve 1, presents the electronic recordings of the pressure surges created in this unprotected system each time the loading valves are operated which is several times during the loading of each transport. Fig. 2, curve 2, gives an indication of the pressure surges found in this same system, same rate of flow, after the installation of a dual-acting desurger. At this installation an efficiency of 90.4 per cent surge removal was measured.

Pressure surges . . . A number of components of this system had failed due to overstressing caused by pressure surges previous to the installation of the desurger—no failure has occurred since.

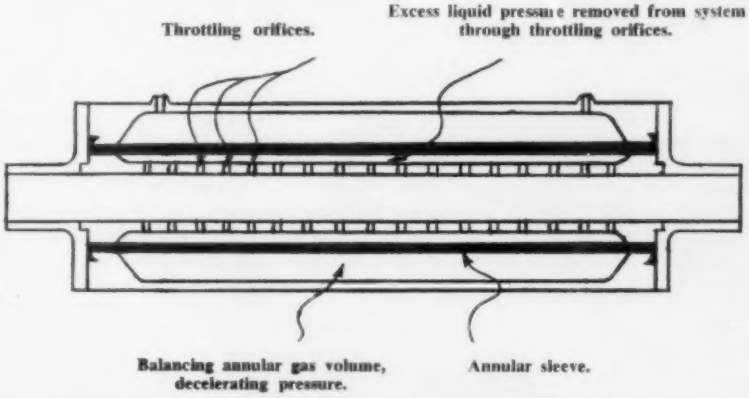
It is very difficult to place a dollar-saved sign on such an installation since the prevention of one failure which is a potential fire hazard would pay for many, many desurgers. Other advantages realized in this installation were the saving of flow measuring instruments, filters, pumps, and other components as well as safer working conditions.



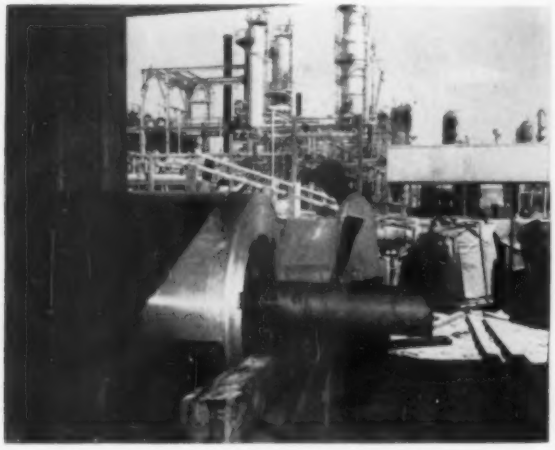
ACTUAL gasoline-truck loading installation looks like this drawing. Normal loading rate is 400 g.p.m. Fig. 1.



CURVE NO. 1 gives electronic recordings of pressure surges unprotected. Curve No. 2 indicates pressure surges after desurger installation. Fig. 2.


Throttling orifices.
Excess liquid pressure removed from system through throttling orifices.
Balancing annular gas volume, decelerating pressure.
Annular sleeve.

THROUGH-FLOW dual-acting inline desurger incorporates two methods of surge removal—throttling orifices and compression chamber. This unit is manufactured by Westinghouse Air Brake Co. Fig. 3.



COIL of aluminum sheet is mounted on arbor for unrolling on job site.

TUBULAR pipe jacket is speedily shaped on light roll former.

Aluminum Sheeting Makes Good Vessel Insulation

ALUMINUM sheet is solving the problem of protecting insulation around pipelines, distillation towers, and other vessels at Shell Oil Co.'s new refinery at Anacortes, Wash.

Designers of the 50,000-bbl. per day facility sought a covering technique which could be easily applied and provide maximum weatherproofing as well as low maintenance costs.

Engineers of Bechtel Corp., prime contractor on the multimillion-dollar project, subcontracted the insulation jacketing job to Peeler-Hansen-Wilson Co., El Paso, Tex.

Kaiser Aluminum & Chemical Corp. supplied more than 150,000 lb. of aluminum sheet for the job, including some 27,000 lb. of corrugated and 125,000 lb. of sheet in coiled form.

Vertical towers . . . To cover insulation surrounding vertical towers corrugated with 1¼-in. pitch, .024-in. gage in sheets 26 by 120 in. was used. Alloy 3003-H14 was selected because of its excellent corrosion resistance.

Pipeline insulation was protected with plain mill-finish aluminum sheet .020-in. gage, coil 36 in. wide.

The typical method of applying the corrugated sheet was demonstrated by its installation on a distilling tower. The tower was 30 ft. in circumference and 120 ft. high. A light scaffolding was erected, and two workers applied the covering, which required 149 sheets of corrugated.

Work proceeded from the bottom. Vertical seams were lapped one and one-half corrugations. The sheet was held in place by a spring-loaded line around the tower's shell to provide support for each course. The end seams were lapped approximately 3 in. Horizontal strapping was applied, and the spring-loaded line was released.

Field shop . . . For the pipeline covering, a field shop was set up to house a portable arbor to handle the coil stock, a conventional sheet-metal shear and a three-roll former for forming the sheet in tubular shape.

End stet joints were lapped 3 in. The end lap joints were held down with straps rather than fastened to allow for the different rate of expansion and contraction between the insulated pipeline and the covering.

On vertical runs of pipe, the covering was installed from the bottom to insure draining away from the end lap joints. S-clips at each circumferential lap prevents slipping.

On horizontal runs, lengthwise lap joints were located on the underside of the pipe to obtain proper drainage away from the joint.

CORRUGATED sheet is held in place on distilling tower by spring loaded sling. Workman is tightening band.

For pipes and vessels less than 36 in. in diameter, the aluminum strapping was ¾ in. wide and 0.020-in. gage. For larger diameter vessels, expansion type of stainless-steel bands were used.

Advantages of the aluminum covering considered were:

1. Competitive in cost with conventional coverings.
2. Comparatively maintenance-free.
3. Ease of installation compared with conventional covering methods.
4. Ease of removal for pipe or vessel inspection and reuse of same panels after inspection completed.

These advantages are in addition to those inherent in the aluminum—light weight, high solar-radiation reflectivity, attractive appearance, and freedom from red rust, and long life.

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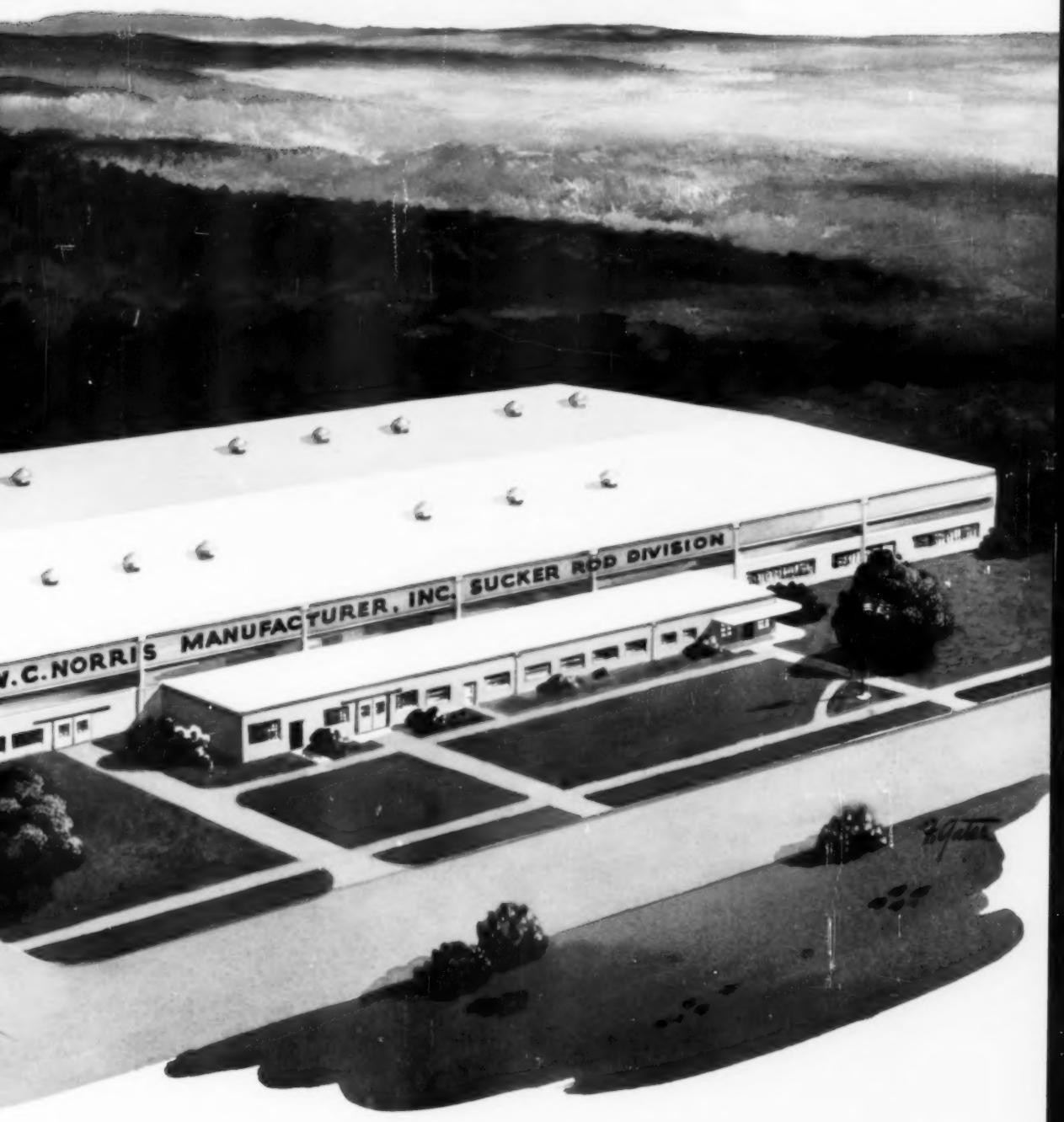
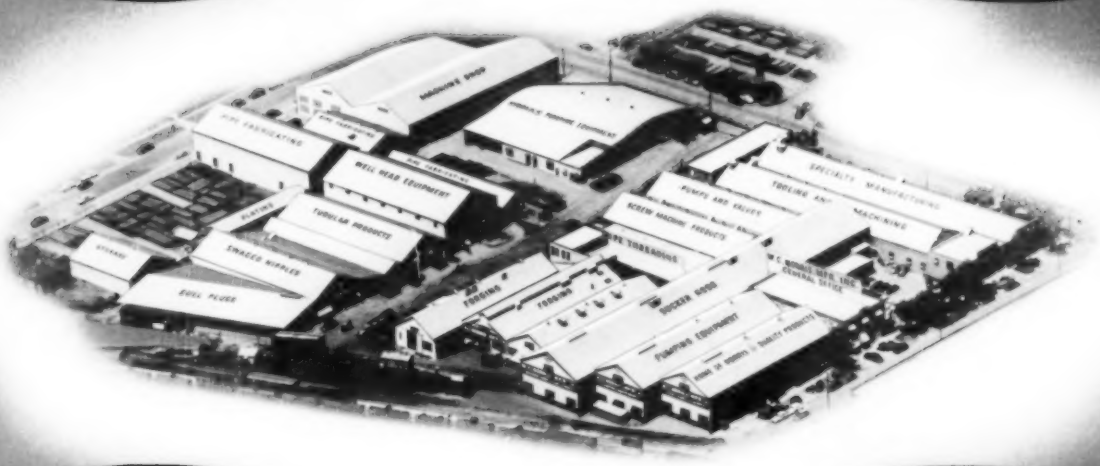


CORPUS CHRISTI
TEXAS

HOUSTON
TEXAS

GREAT BEND
KANSAS

KILGORE
TEXAS



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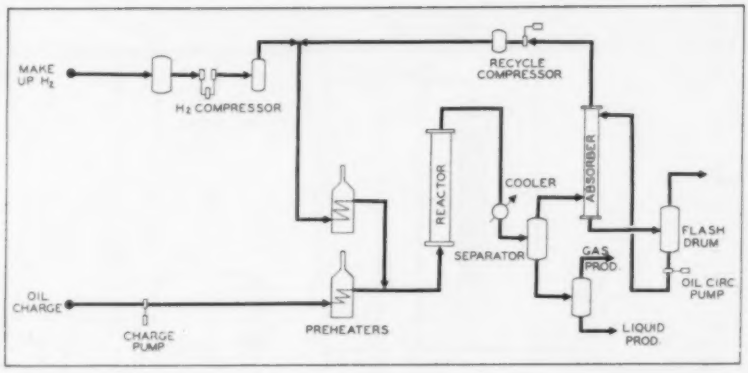
H-OIL PILOT PLANT was used to investigate the variables which control this new process. Makeup hydrogen is made by partial oxidation of natural gas. Fig. 1.



The "H-Oil" Process

It's flexible—with capacity to gage its products to shifting demands

By H. Pichler,* M. Chervenak, C. A. Johnson, M. C. Sze, and J. F. Campagnolo
Hydrocarbon Research, Inc.

THE "H-OIL" process developed by Hydrocarbon Research, Inc., reduces refinery residual stocks to the plant fuel requirement and converts the remainder into valuable distillate products. In addition, by adjusting operating conditions this process has the flexibility to produce varying quantities of each distillate product depending on changes in demand, seasonal or otherwise.

With the use of a specially designed reactor, the catalyst bed, even for deep hydrogenation, is operated essentially isothermally. At no time in hydrogenating heavy residues is the temperature differential across the reactor in excess of 20° F. Consequently, the entire catalyst bed can be operated at the optimum reaction temperature for the particular charge stock.

This permits the operation to be conducted continuously at a high space velocity, thus requiring comparatively a small reactor volume and a less costly reactor. With essentially isothermal operation at the optimum temperature, coke laydown becomes no problem and long onstream time is thus attained.

Pilot plant . . . A 25-bbl. per day pilot plant, constructed to investigate the process, is shown schematically in Fig. 1. The makeup hydrogen is made by partial oxidation of natural gas. After the makeup hydrogen is compressed to the same pressure, it joins the recycle hydrogen and the stream is preheated.

Hot, heavy residue charge stock is pumped up to system pressure and preheated. The total hydrogen and oil feeds then enter the reactor. In the reactor, the feed oil is contacted with hydrogen in the presence of a standard commercial desulfurization catalyst and undergoes hydrodesulfurization, hydrogenation, and some hydrocracking reactions.

The net effect of these reactions is to yield a high conversion of the residual material to lighter distillates of high quality, especially with regard to sulfur, nitrogen, and oxygen contents. The reactor effluent is cooled and the condensed oil is separated from the hydrogen in a separator.

Before it is recycled, the hydrogen from the separator is scrubbed with oil to remove some inert constituents. High-pressure liquid is let down to atmospheric pressure and the gas and liquid products are collected and analyzed.

In addition to the pilot plant, Hydrocarbon Research Institute's laboratory has also operated many small units for several years. These bench-scale units have charge rates of about 300 cc. per hour. From the parallel

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Why this process?

THERE is a need for a process which converts heavy residual stocks into high quality lower-boiling distillate fractions which are also very low in sulfur. With this goal in mind Hydrocarbon Research, Inc., has worked for several years in developing the "H-Oil" process at its Trenton, N. J., laboratories.

Before a process which would treat a wide range of stocks could be made available commercially it was necessary to solve many problems.

One problem was the availability of cheap hydrogen for hydrogenation use. While in many refineries today, adequate cheap hydrogen is available from catalytic reforming operations, other refineries still must produce, in part or in whole, their hydrogen requirements, if hydrogenation processing is to be adopted.

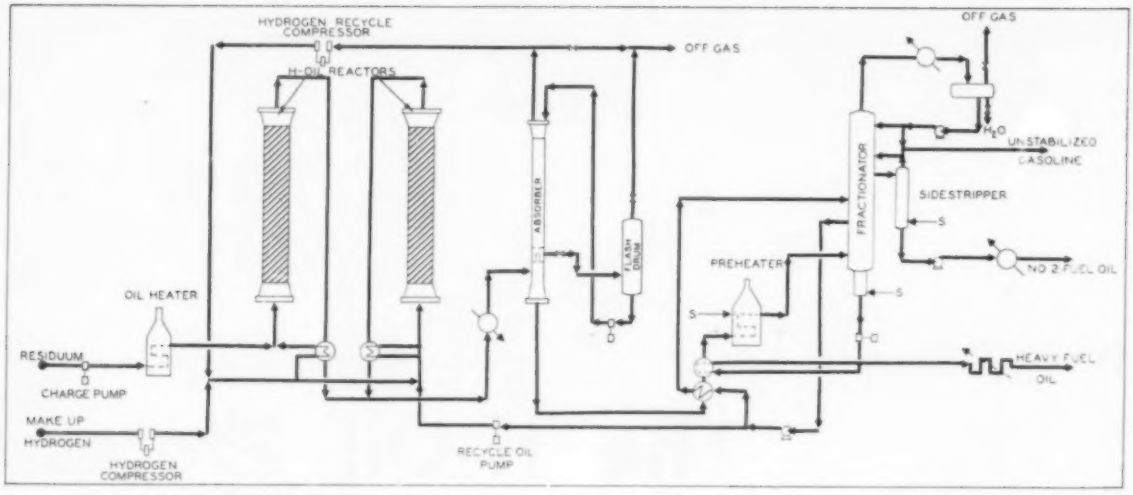
With the recent commercial success of the partial oxidation process as licensed by Texaco Development Co. and Hydrocarbon Research, Inc., the tool to produce hydrogen from all types of refinery distressed stocks becomes available. The supply of hydrogen thus constitutes no problem.

Other Problems

Other problems which had to be solved were mainly related to the hydrogenation reactor, which is the heart of the process. In the development of the process, the following requirements were set up:

1. The reactor must give efficient contact of hydrogen and liquid hydrocarbons at low pressure drop.
2. In treating heavy residues, metal salts in the residue must not affect the catalyst performance.
3. The same reactor must be capable of remaining onstream continuously for long periods of time even when treating heavy residues, so that no expensive short-period cyclic regeneration operation is necessary. This is difficult to attain, especially when deep hydrogenation is attempted.
4. Since the hydrogenation reaction is highly exothermic, there must be positive and efficient control of temperature throughout the catalyst bed. Unless controlled, the heat liberated in deep hydrogenation can raise the temperature of the reactants several hundred degrees Fahrenheit.

In such a catalyst bed only a small fraction of the bed would be at optimum temperature and there would be a rapid laydown of coke due to thermal cracking in the overheated sections of the bed. With the rapid coke laydown, frequent regeneration or cyclic operation then becomes a necessity.



COMMERCIAL H-OIL PLANT is operated as shown in this schematic flow sheet. Fig. 2.

operation of the bench-scale units and the large pilot plant, wide ranges of feed stocks have been processed varying not only in specific gravity, sulfur content, and Conradson carbon, but also in hydrogen-carbon ratio.

The following stocks which have been processed indicate the variety which can be handled in the process: (1) catalytic cracker cycle oil, (2) fluid catalytic cracker decant oil, (3) vacuum Kuwait residue, (4) Mid-Continent residue, (5) furfural extract, and (6) propane deasphalter tar.

When running on an 8° A.P.I. heavy Kuwait residue, the large pilot plant reactor stayed on stream continuously for over 1,200 hours, followed by voluntary shutdown.

Typical Results

Examples of the versatility of the process are shown in Table 1. These data show results from the processing of 8° A.P.I. Kuwait residuum and a blend of heavy nonresiduum stocks. These stocks consisted of furfural extract and T.C.C. synthetic tower bottoms.

The typical results of Table 1 indicate the high degree of desulfurization achieved. About 80 per cent of the sulfur in the Kuwait residuum was removed at a conversion level of 71 per cent, and the hydrogen-carbon ratio was increased from 1.47 to 1.79. The results for the lighter charge stock indicate that 98 per cent desulfurization is achieved. The H/C ratio for this stock was increased from 1.50 to 1.91.

As in other deep hydrogenation processes, the yield of C_4 plus liquids is in excess of 100 volume per cent, generally about 103 to 105 per cent. The products obtained are of superior quality. The heavy gas oil is low in sulfur and high in H/C ratio. It is a choice catalytic cracking charge. The No. 2 distillate or diesel cut is a low-sulfur high-stability marketable product. The gasoline has low sulfur but requires reforming to improve its octane to the usual refinery pool octane level.

Selective hydrogenation . . . In the course of developing this process, it soon became evident that the heavy-gas-oil fraction produced in the processing of heavy residuums can be advantageously recycled to a second reactor operating under slightly different conditions to yield directly high-grade No. 1 or No. 2 distillates. Other refinery distress distillate stocks, such as furfural extract, may also be charged to the same second reactor.

Experimental investigation has since demonstrated the practicability of such a two-reactor system.

TABLE 1—EXAMPLES OF VERSATILITY OF PROCESS

	Kuwait resid.	Furfural extract + T.C.C. syn. tower btms.
Charge:		
Gravity °A.P.I.	8.3	9.1
Sulfur, wt. per cent	5.32	1.39
Ramsbottom carbon, wt.	17.2	1.29
Hydrogen consumption, s.c.f./bbl. of charge	1,500	2,050
Yields:		
Product fractions:		
C_4's, vol. per cent yield	2.5	2.7
Gasoline (C_5-380°) yield, vol. %	19.8	24.3
Inspections:		
Gravity, °A.P.I.	53.5	52.6
Sulfur, wt. %	0.058	<0.01
Aniline point, °F.	130	127
Bromine number	2.0	0.6
No. 2 distillate fuel oil (380°-650°) yield, vol. %	24.0	42.4
Inspections:		
Gravity, °A.P.I.	34.7	32.4
Sulfur, wt. %	0.17	0.02
Aniline point, °F.	136	133
Bromine number	5.0	3.9
Heavy gas oil, boiling range, °F.	650-975	650-850
Yield, vol. %	29.1	31.2
Inspections:		
Gravity, °A.P.I.	21.7	.....
Sulfur, wt. %	0.64	0.08
Residue:		
Yield, vol. %	*29.4	†4.2
Inspections:		
Gravity, °A.P.I.	9.1	.....
Sulfur, wt. %	2.52	.....

*975° F. +. †850° F. +.

Process Variables

The following process variables have been investigated in the laboratory development work:

Temperature — The severity or degree of hydrogenation can be controlled by adjusting the temperature of the catalyst bed. Depending upon the charge stock and the anticipated results, the optimum temperature ranges from 700° to 875° F., with a temperature spread across the catalyst bed of 20° F. maximum.

Space velocity—This is defined as the volumes of oil flow per hour per volume of catalyst. The severity of the operation can be varied by adjustment of space velocity, the higher the space velocity the lower the severity. Hence, temperature and space velocity can be varied independently for optimum processing of a particular stock.

Usually for treating lighter distillates, a space velocity of 5.0 or more can be used. For processing heavy residues continuously, a space velocity of 1.0 is more desirable.

Pressure—In developing this process, H.R.I. has investigated a wide pressure range from 500 to 3,000 psig. Generally, the heavier charge stocks

require higher pressures to obtain high desulfurization and high yields of light distillates. For treating light distillates, lower pressures are entirely satisfactory.

Coke laydown—When heavy residuums are processed, it has been found that there is a slight coke laydown on the catalyst. But due to the excellent temperature control, the rate is very slow and a long continuous run can easily be counted on. The ability to maintain catalyst activity can be shown by data given in Table 2 which compares the results obtained at two periods of the same continuous run. Activity after 1,170 hours is only slightly under that after 370 hours.

Hydrogen consumption—This is a function of the type of stock processed and severity of operation. For stabilization of middle distillates with some desulfurization, the hydrogen consumption can be limited to 100 to 200 s.c.f. per barrel of feed oil. In several operations with high sulfur residuums and at conversions in the order of 75 per cent, the hydrogen consumption will be from 1,000 to 1,400 s.c.f. per barrel of feed oil.

When treating materials of low H/C ratio and high sulfur contents, hydrogen consumption of 1,800 s.c.f. or more per barrel has been experienced.

Purity of hydrogen — Except for fairly large concentrations of carbon monoxide, the impurities normally present in hydrogen-rich streams, such as nitrogen and light hydrocarbons, do not have any adverse effect either on the catalyst or to the process. If these inerts were permitted to build up to high concentrations, the effective hydrogen partial pressure would be reduced and it would be necessary to raise the system pressure to offset this effect.

TABLE 2—EFFECT OF CATALYST AGE ON ITS ACTIVITY

(Charge stock—8° A.P.I. Kuwait residuum)

	After 370 hours on stream	After 1,170 hours on stream
Product yields:		
Cl-C_3, wt. %	2.5	3.3
C_4-400° F., vol. %	14.8	15.7
400°-650° F., vol. %	18.6	21.0
650°-975° F., vol. %	43.4	35.2
975° F.+, vol. %	27.1	31.0
C_4+ liquids, vol. %	103.9	102.9
Conversion (100-vol. % 975° F.+)	72.9	69.0
Inspections on fractions:		
I.b.p.—400° F.:		
Gravity, °A.P.I.	56.8	56.9
Sulfur, wt. %	Negligible	Negligible
400°-650° F.:		
Gravity, °A.P.I.	34.7	35.1
Sulfur, wt. %	0.097	0.14
650°-975° F.:		
Gravity, °A.P.I.	21.0	20.6
Sulfur, wt. %	0.75	1.07
975° F.+:		
Gravity, °A.P.I.	8.2	5.5
Sulfur, wt. %	2.50	3.47

TABLE 3—ECONOMICS OF 14,000-BBL. PLANT

Basis: Complete plant, H_2 manufacturing plant, products recovery and M.E.A. Offgas Purification Unit

Plant investment	$11,200,000
Capacity, bbl. per stream day	14,000
Stream efficiency, per cent	90

	Unit	Daily quantity	Unit cost	Daily cost	Cost/daily bbl.
1. Oil charge:					
Feed (H-Oil unit)	Bbl.	14,000	$1.50	$21,000.00	$1.500
Feed (H_2 plant)	Bbl.	1,800	1.50	2,700.00	0.193
				$23,700.00	$1.693
2. Materials:					
H-Oil catalyst	Lb.	1,165	$0.95	$ 1,106.75	$0.0792
M.E.A.	Lb.	15	1.30	4.50	0.0003
H_2 plant chemicals				48.00	0.0034
H_2 plant shift catalyst	Lb.	150	0.60	90.00	0.0064
Lube oil	Gal.	42	1.00	42.00	0.0030
				$ 1,291.25	$0.0923
3. Utilities:					
Condensate	M gal.	41	$0.20	$ 8.20	$0.0006
Cooling water	M gal.	21,450	0.02	429.00	0.0307
Steam 400 psig., 550° F.	M lb.	2,055	0.42	863.10	0.0616
Steam 150 psig., sat.	M lb.	602	0.40	240.80	0.0172
Steam 50 psig., sat.	M lb.	96	0.35	33.60	0.0024
Power	Kw.-hr.	33,600	0.008	268.80	0.0192
				$ 1,843.50	$0.1317
Credit for offgas (970 B.t.u./s.c.f.)	M.s.c.f.	2,800	0.30	—840.00	—0.0600
				$ 1,003.50	$0.0717
4. Labor	Man-hr.	216	*2.75	$ 594.00	$0.0424
5. Supervision at 35% direct labor				207.90	0.0148
Total labor				$ 801.90	$0.0572
6. Maintenance at 3%/year of investment				$ 1,020.00	$0.0728
7. Taxes and insurance at 2%/year of investment				680.00	0.0486
Total costs before depreciation				$28,496.65	$2.035
8. Depreciation at 10%/year of investment				3,400.00	0.243
All costs—total				$31,896.65	$2.278

*Including fringe benefits, etc.

TABLE 4—PAYOUT TIME FOR 14,000-BBL. PLANT

Income from products obtained:

	Vol. % on charge to H-Oil unit	B/SD	Unit price	Daily income
C_4+ gasoline	33.8	4,730	$4.20/bbl.	$19,850
No. 2 fuel oil	45.4	6,350	$4.20/bbl.	26,650
Heavy fuel	26.5	3,710	$1.50/bbl.	5,565
	105.7	14,790		$52,065
Daily costs (including charge stock but excluding depreciation and royalty)				28,497
Profit before depreciation—daily				$23,568
Profit before depreciation—yearly				$7,778,000

Payout time—1.4 years.

Two economic studies have been worked out for plants processing residual stocks. These plants have been designed for throughputs of 14,000 and 5,000 bbl. per stream day. A simplified flow sheet for the oil processing is shown in Fig. 2.

Heavy residuum is pumped up to system pressure, preheated in a fired heater, and charged to one of two

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reactors. Required hydrogen is also fed to this reactor. Makeup hydrogen after being compressed to system pressure is mixed with recycle hydrogen. The mixed hydrogen stream is preheated by heat exchange with the reactor effluent before joining the heavy-residual charge.

The reactor effluent is cooled first by heat exchange against incoming hydrogen and then by cooling water to ambient temperature. The vapor and liquid mixture, together with those from the other reactor, flows to a separator, from which the liquid product is withdrawn through a letdown valve.

The recycle hydrogen stream from the separator is scrubbed with lean oil and is then recycled by a booster compressor. The rich oil from the scrubber is let down in pressure in a flash drum, releasing the absorbed constituents and is then pumped back to the top of the absorber.

The product liquid flows from the separator through exchangers where it is preheated; through a furnace where, with the aid of steam injection, the desired degree of vaporization is accomplished; and then to a fractionator. The fractionator separates the product into gasoline. No. 2 distillate fuel oil, heavy gas oil, and residuum fuel oil.

The residuum oil exchanges heat against fractionator feed and is cooled in a box-type cooler before going to storage. A portion of the heavy-gas-oil sidestream gives up heat to the tower feed, while the remainder is recycled to the other reactor.

Any distress refinery distillate stocks such as catalytic cracker cycle stock may also be charged to this second reactor. The second reactor system is similar to the first except in operating conditions.

For the 14,000-bbl. per stream day unit, it is assumed that the unit must **supply its entire hydrogen requirement** by a hydrogen plant using the partial-oxidation process. It further includes a monoethanolamine scrubbing unit for desulfurizing the offgas. Part of the offgas is used to drive gas-engine-driven compressors and to fire the process heaters.

For the 5,000-bbl. per stream day unit, it is assumed that byproduct hydrogen from a catalytic reformer is available at the refinery and no hydrogen manufacturing facilities are included.

In Tables 3 and 4, the economics for the 14,000-bbl. complete plant is presented. The payout is about 1.4 years, an attractively short time. Similarly, Tables 5 and 6 present the economics for the smaller 5,000-bbl. plant. Due to the fact that byproduct hydrogen is available, a similarly attractive payout time is obtained.

Out-of-pocket processing cost is low. From Tables 3 and 5, this cost, excluding charge stock, is approximately 35 cents per barrel of oil charged to the unit.

Applications . . . The process is a very flexible one. It may be used to desulfurize or stabilize light distillates. It may also be used to improve diesel index or cetane number of cracked middle distillates. If a refinery plans to run a high-sulfur crude oil, the process may be used with advantage to desulfurize and hydrogenate the whole crude prior to topping or other refining operations. **End.**

TABLE 5—ECONOMICS OF 5,000-BBL. PLANT

Basis: Plant with M.E.A. Offgas Purification Unit, Products Recovery and H_2 Compression

Plant investment	$4,200,000
Capacity, bbl. per stream day	5,000
Stream efficiency, per cent	90

	Unit	Daily quantity	Unit cost	Daily cost	Cost/daily bbl.
1. Feed:					
Oil	Bbl.	5,000	$1.50	$ 7,500.00	$1.500
Cat. reformer H_2	M.s.c.f.	10,000	0.11	1,100.00	0.220
				$ 8,600.00	$1.720
2. Materials:					
H-Oil catalyst	Lb.	416	$0.95	$ 395.20	$0.0792
M.E.A.	Lb.	5	0.30	1.50	0.0003
Lube oil	Gal.	14	1.00	14.00	0.0028
				$ 410.70	$0.0823
3. Utilities:					
Cooling water	M gal.	4,450	$0.013	$ 57.80	$0.0116
Steam 150 psig., sat.	M lb.	275	0.40	110.00	0.0220
Steam 50 psig., sat.	M lb.	35	0.35	12.25	0.0025
Power	Kw. hr.	8,950	0.008	71.60	0.0143
				$ 251.65	$0.0504
Credit for offgas (970 B.t.u./s.c.f.)	M.s.c.f.	1,430	$0.30	$ 429.00	$0.0858
Steam, 400 psig. sat. produced	M lb.	165	0.40	66.00	0.0132
Total credit				$ 495.00	$0.0990
Net utility credit				$ 243.35	$0.0485
4. Labor	Man-hr.	96	*$2.75	$ 264.00	$0.0528
5. Supervision at 35% of direct labor				92.40	0.0185
Total labor				$ 356.40	$0.0713
6. Maintenance at 3%/year of investment				$ 382.00	$0.0765
7. Taxes and insurance at 2%/year				254.66	0.0510
Total costs before depreciation				$ 9,760.41	$1,953
8. Depreciation at 10% year				1,275,00	0.255
Total				$11,035.41	$2,208

*Includes fringe benefits, etc.

TABLE 6—PAYOUT TIME FOR 5,000-BBL. PLANT (REFER ALSO TABLE 5)

Income from products obtained:

	Vol. % on charge to H-Oil unit	B/SD	Unit price	Daily income
C_4+ gasoline	33.8	1,690	$4.20/bbl.	$ 7,100
No. 2 fuel oil	45.4	2,270	$4.20/bbl.	9,540
Heavy fuel	26.5	1,320	$1.50/bbl.	1,980
	105.7	5,280		$18,620
Daily costs (including charge stock but excluding depreciation and royalty)				9,760
Profit before depreciation—daily				$8,860
Profit before depreciation—yearly				$2,924,000
Payout time—1.4 years.				

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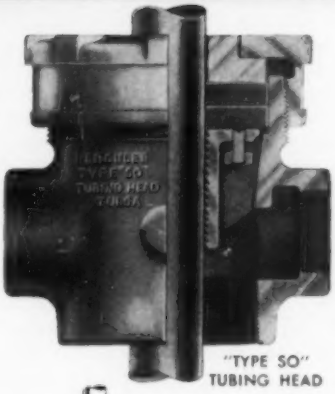

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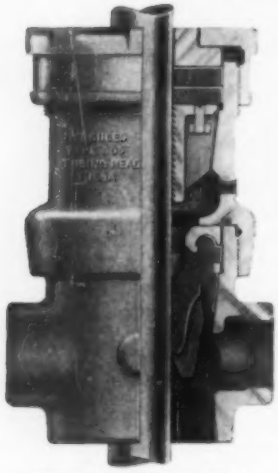

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QUESTIONS ON TECHNOLOGY

Obsolescence in Lubricating-Oil Manufacture

Lubricating-oil production is very expensive. Has obsolescence occurred more rapidly in this area then in the other fields of processing that you have discussed?—M.G.I.

Although lubricating-oil manufacture is expensive, the changes in this branch of the industry have been relatively infrequent (Tables 1 and 2) and note also that only a small amount of lubricating oil is produced compared with most other oil products.

The dewaxing of viscous oils has undergone only three major changes, namely, (1) cold settling, 1900, (2) centrifuge, 1922, and (3) solvent dewaxing, 1935. Meanwhile paraffin distillate dewaxing has had only two stages of processing, pressing (1891) and solvent dewaxing (1935). Wax was first sweated (1891) and is now deoiled with solvents (1945). Lubricating oil was first treated with sulfuric acid (1880), percolated through clay (1915), contacted with fine clay (1928), and finally extracted with solvents (1933). However, acid and clay are still widely used as finishing operations from solvent extraction.

Adoption of new methods of lubricating-oil processing has been slow. During 1955 about 9.5 per cent of the treating was still done by conventional methods (1915) or 90.5 per cent by solvent extraction (1933). Likewise only 86.2 per cent of the dewaxing is done with solvents even though this process was widely used in 1935 and the old conventional method was in vogue before 1912. Continuous pipe-still vacuum distillation (1930) has, however, completely displaced steam-still reduction (1905).

Technology of Lube-Oil Manufacture

Cylinder stock or axle grease was the natural reduction product when Pennsylvania oils were first distilled. Acid treatment and caustic neutralization were known from almost the first (1860) but lubricating oil was not produced in quantity until 1890-1900. The fact that part of the wax could be settled from crude oil by allowing it to stand over the winter in storage was discovered accidently about 1890 and by 1894 such a practice was followed by most refiners (A. W. Nash, J. Inst. Pet. Tech., 26, p. 41, Feb. 1940). By 1900, cold settling (Miller, W., OGJ, Aug. 20, 1922, p. 35) of cylinder stock diluted with naphtha was widely practiced and by 1922 the Sharples centrifuge process was developed for separation of high-melting wax (petrolatum) from cylinder stock.

Meanwhile the wax distillate was pressed and sweated (1891) by the same processes as those used in the earlier Scotch shale-oil industry. By 1905 steam was used extensively (so-called steam-refined stocks) and by 1915 the usefulness of permitting some cracking to take place for the production of a large percentage of paraffin or wax distillate was recognized. During this same period (1912) the familiar Gray wax-molding press was adopted and chipping machines for bag packing were employed. Pour-point depressants have been used to some extent since 1931.

Bauxite and clay percolation filtration were in use by 1915 and reburning of the coarse clay was accomplished in rotary burners (1922) and multiple hearth burners (1925). Not until 1935 was a new method of burning introduced (Thermofor kiln) and it has since been used (1953) in a continuous system of clay filtration.

Lubricating-oil manufacture was greatly expanded after 1929 when pipe-still continuous vacuum distillation was developed because it permitted the processing of crude oils which contained large amounts of black asphaltic material. A wide variety of raw lubricating-oil stocks became available and solvent-extraction processes (1930-1932) were required in upgrading these inferior materials as well as propane deasphalting (1935) for the elimination of asphalt. The application of solvents to dewaxing was a logical advancement (1935), and by 1945 a solvent was also used to deoil paraffin wax, displacing the very old wax-sweating process. Continuous wax molding was also introduced about 1952, and at the present time interest is evident in the urea room-temperature dewaxing process which can be used to produce oils having pour points as low as minus 70° F.

The use of additive materials for oxidation resistance, detergency, foaming, etc., made great strides during World War II, and such agents are used today in most lubricating oils.

TABLE 1—CHRONOLOGY OF DEWAXING TECHNOLOGY

1871	Patents on wax sweetening
1891 (1890-1905)	Natural cold-settling in crude storage tanks
1891 (1871-1955)	Henderson sweating houses and Moore filter presses
1900 (1895-1925)	Cold settling with naphtha
1910 (1905-1935)	Cracking distillation for increasing paraffin-wax yield
1912 (1910-)	Gray wax-molding press, chipping machines, etc.
1922 (1920-1955)	Centrifuge (Sharples) dewaxing
1933 (1930-)	Pour-point depressants
1935 (1927-)	Solvent dewaxing
1945 (1940-)	Solvent deoiling
1955 (1950-)	Continuous wax molding
1957+(1955-)	Urea room-temperature dewaxing

TABLE 2—CHRONOLOGY OF LUBRICATING OIL TREATING AND MANUFACTURE (EXCEPT DEWAXING—SEE TABLE 1)

1880 (1860-1915)	Shell still reduction
1880 (1860-)	Acid treatment, caustic neutralization
1890	Lubricating oils in quantity
1905 (1900-1935)	Steam still reduction
1915 (1910-)	Bauxite and clay percolation, brightening, etc.
1922 (1920-)	Rotary clay burners
1928 (1923-)	Clay contact filtration
1930 (1925-)	Multiple hearth clay burners
1930 (1925-)	Vacuum (continuous) distillation
1932 (1910-)	Edeleanu sulfur dioxide extraction
1933 (1928-)	Solvent extraction processes
1935 (1932-)	Propane deasphalting
1939 (1935-)	Thermofor kiln burning of clay
1945 (1938-)	Additive agents for lubricating oils
1953 (1951-)	Thermofor continuous clay percolation

West Coast Plans New Refineries

Alaska-Yukon Refiners & Distributors, Ltd., will complete a $6,000,000, 7,500-bbl. per day refinery at Haines, Alaska, in 1958. It will include a 2,500-bbl. daily thermal cracking unit.

British American Oil Co., Ltd., will complete by late 1958, a 20,000-bbl. per day plant at Port Moody, B. C. It will include atmospheric and vacuum crude distillation, Orthoflow, Catforming, catalytic cracking, alkylation, and hydrogen treating.

Cal-Mex Oil & Refining Co. has let a $27,000,000 contract to Ralph M. Parsons Co. for a 20,000-bbl. daily plant in the San Diego, Calif., area. Plant, to be completed early 1959, will include a catalytic cracker, catalytic desulfurizer, catalytic reformer, and sulfur-recovery unit.

Douglas Oil Co. will increase crude capacity 12,000 bbl. per day at Bakersfield, Calif., by December 1957.

Fletcher Oil Co. will complete a 3,000-bbl. daily Platformer and a 3,000-bbl. daily Unifiner April 1958, at Wilmington, Calif.

General Petroleum Corp. will complete a multimillion dollar 12,000-bbl. daily Sovaformer at Torrance, Calif., October 1957. Engineering is by Socony Mobil Oil Co., Inc., and Bechtel Corp. Construction is by Ralph M. Parsons Co.

Golden Bear Oil Co. is considering adding furfural extraction capacity and modernizing acid-treating facilities at Oildale, Calif. Plans include adding 500 bbl. daily hydrogen-treating capacity at a cost of $350,000.

Hancock Oil Co. is increasing crude capacity 7,000 bbl. per day, visbreaking capacity 3,450 bbl. per day, and Thermofor capacity 2,100 bbl. per day at Signal Hill, Calif. Ralph M. Parsons Co. has contract.

Pacific Petroleums, Ltd., and **Phillips Petroleum Co.** are building a $15,000,000 refinery at Taylor, B. C. It will include distillation, catalytic desulfurization and reforming, dehydrogenation, butane isomerization, and alkylation. Pacific will operate plant.

Richfield Oil Corp. plans a new $50,000,000 refinery at Everett, Wash. Probable completion date will be in 1965.

Rothschild Oil Co. is adding an 8,000-bbl. per day catalytic cracking unit at Santa Fe Springs, Calif., at a cost of $2,000,000. C. F. Braun & Co. has contract.

Royalite Oil Co., Ltd., will complete a 1,000-bbl. daily Unifiner at Kamloops, B. C., October 1957.

Shell Oil Co. is building a multimillion dollar, 2,400-bbl. daily sulfuric acid alkylation unit at Anacortes, Wash. Fluor, Ltd., has contract and will complete job in 1958.

At Wilmington, Calif., a 16,000-bbl. daily Platformer is being built by Kaiser Engineers.

Standard Oil Co. of California will increase crude capacity 12,000 bbl. daily and vacuum capacity to charge topped crude 20,000 bbl. per day at Segundo, Calif., by end of 1957. Fluor Corp. has vacuum unit.

At Everett, Wash., a $75,000,000, 60,000 to 100,000-bbl. per day plant will be built.

At Richmond, Calif., crude capacity will be upped 39,000 bbl. per day by late 1957. By mid-1958, a 20,000-bbl. daily reformer will be completed.

At Bakersfield, Calif., a 3,000-bbl. per day catalytic reformer will be completed mid-1958.

The Texas Co. will complete a 40,000-bbl. per day refinery at Anacortes, Wash., by January 1, 1959. It will include 25,000-bbl. daily fluid catalytic cracking 7,000-bbl. daily Platforming, catalytic polymerization, sulfuric acid alkylation, and Hydrotreating. General construction is by Bechtel Corp. Furnishing and erection of tankage is by Chicago Bridge & Iron Co.

Tidewater Oil Co. will complete a 22,500-bbl. daily Houdriformer at Avon, Calif., March 1958. Bechtel Corp. has contract.

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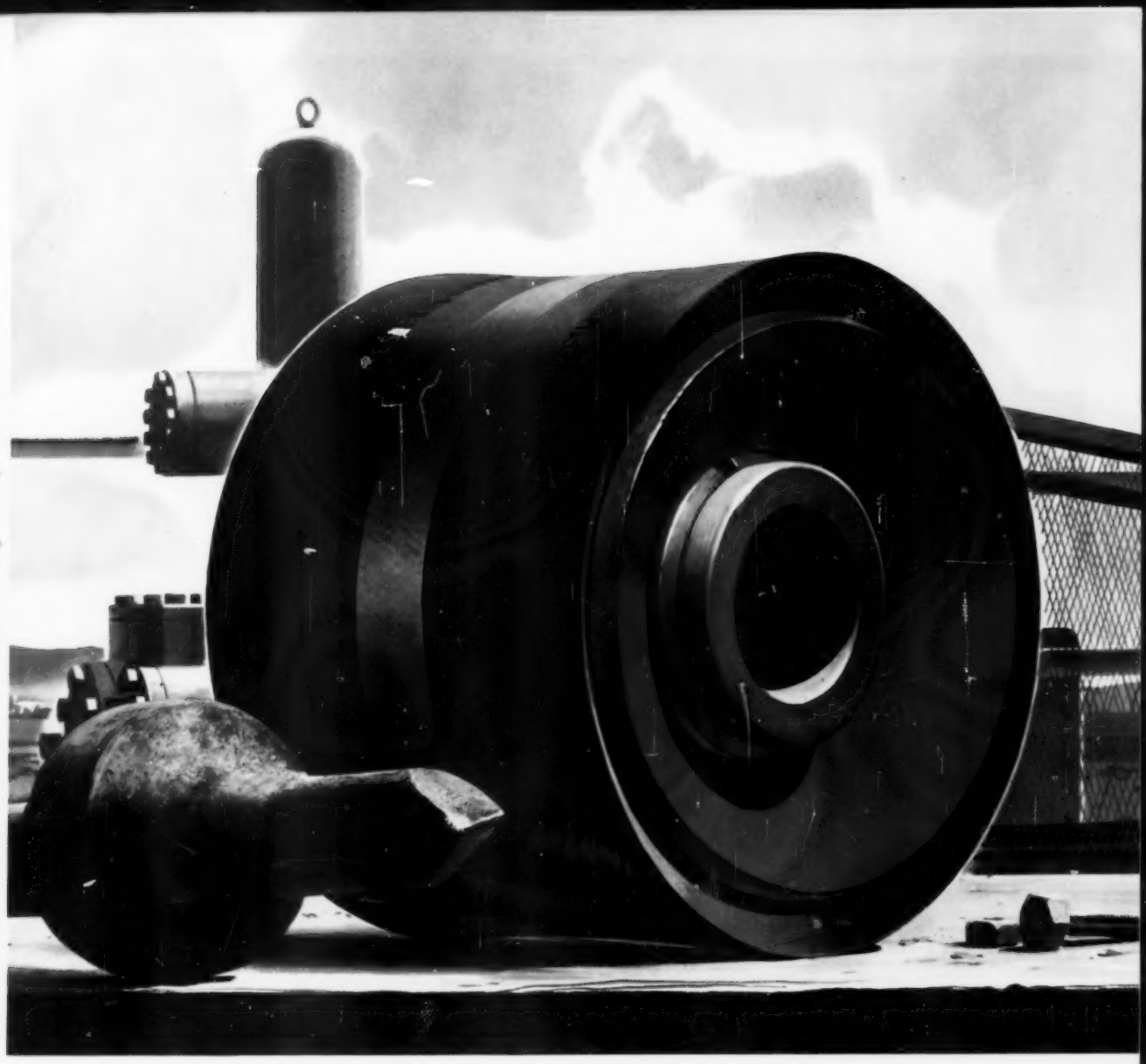

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Pipeline Patrol

... Report on Construction

PIPELINE activity reported here is compiled from surveys conducted by The Oil and Gas Journal among pipeline companies and contracting firms. Projects listed include those proposed, contracted, and under way.

U.S. Crude-Oil Pipelines

• **Belle Fourche Pipeline Co.**
Project: 30 miles of 6-in. from Donkey Creek pool to Fiddler Creek pool in northeastern Wyo. Will later build a line from Fiddler Creek to connect with Butte Pipe Line Co. near Osage, Wyo.
Status: Planned.

• **Cape Pipe Line Co.** (Sun Oil Co., Cities Service Co., Atlantic Refining Co.)
Project: Line from lower Delaware Bay to Philadelphia.
Status: Long range plans.
Completion: 1960.

• **Forest Pipeline Corp.**
Project: 35 miles of 8-in. from Grieve field, Wyoming, to Platte Pipe Line at Casper.
Status: Under way.
Completion: Fall 1957.

• **Four Corners Pipe Line Co.** (Shell, Standard of Calif., Continental, Gulf, Richfield, Superior)
Project: 635 miles of 16-in. from Aneth field in southern Utah to Los Angeles, 86 miles of 12-in. from New Mexico's Bisti field to Red Mesa station 35 miles southeast of Bluff, Utah, and 3 miles of 6, 8, 10-in. feeder lines from other fields in New Mexico and Utah. Will be operated by Shell Pipe Line.
Status: Under way.
Contractor: **A. P. Vaughn Construction Co.** and **Potashnick Construction Co.** have 170 miles of 16-in. from Aneth field to Cameron, Ariz., and 100 miles of 16-in. from Seligman to the Colorado River. **R. H. Fulton Construction Co.** has 98 miles of 16-in. from Cameron to Seligman, Ariz., and 217 miles of 16-in. from the Colorado River to Olive, Calif. **Pacific Pipeline Co.** has 46 miles of 16-in. from Olive to Los Angeles; **Standard Pipeline Contsruction Co.** has feeder lines.
Completion: January 1958.

• **Great Northern Railway Co.**
Project: 400 to 600 miles of 12 to 20-in. from Williston basin in Montana and North Dakota, to Clearbrook or St. Paul, Minn.
Status: Planned.
Contractor: **Pipe Line Technologists, Inc.** has completed feasibility study.

• **Interstate Oil Pipe Line Co.**
Project: 5 miles of 4-in. from South Bosco field, and 5 miles of various size from Church Point field, La., to present main line.
Status: Proposed.

• **Magnolia Pipe Line Co.**
Project: 24 miles of 20-in., 20 miles of 12-in., 83 miles of 16-in. from Corsicana to Clyde, Tex.
Status: Under way.
Contractor: **H. B. Zachry Co.**
Completion: November 1, 1957.
Project: 120 miles of 16-in., 4 miles of 12-in. from Clyde to Midland, Tex.
Status: Under way.
Contractor: **O. R. Burden Construction Corp.**
Completion: December 31, 1957.

• **Muskegon Pipe Line Corp.** (Aurora Gasoline Co., Service Pipe Line Co.)
Project: 165 miles of 10-in. from Griffith, Ind., to Muskegon, Mich.
Status: Under way.
Contractor: **Midwestern Constructors, Inc.** has two spreads working: North end, W. T. Wilhite, supt., office at Coloma, Mich.; South end, office at Chesterton, Ind.
Completion: Late 1957.

• **Northwest Pipeline Corp.**
Project: 80 miles of 8-in. and 300 miles of 10-in. crude and products line from Four Corners area to Salt Lake City.
Status: Proposed.

• **Offshore Gathering Corp.**, Houston.
Project: 364 miles of mostly 20-in. in Gulf of Mexico off Louisiana. (Dual line.)
Status: Proposed.

• **Oil Field Pipe Line, Inc.**
Project: 200 miles 8 and 12-in. line from near Elkhart, to Ellinwood, Kans.
Status: Proposed.

• **Salt Lake Pipe Line Co.**
Project: 93 miles of 10-in. loops from Rangely, Colo., to Salt Lake City.
Status: Under way.
Contractor: **Engineers Limited Pipeline Co.**
Completion: December 1, 1957.

• **Service Pipe Line Co.**
Project: 4 miles of 12-in. loop between Dyer and Griffith, Ind., and 8 miles of 24-in. loop in Will County, Ill.
Status: Under way.
Contractor: **O. R. Burden Construction Corp.**

• **Sinclair Pipeline Co.**
Project: 150 miles of 20-in. from League, Tex., to Houston.
Status: Planned for 1958.
Completion: 1958.

• **Skelly Oil Co.**
Project: 38 miles of 8-in. extension of its gathering system into southern Kiowa County, Kansas.
Status: Under way.
Completion: Early fall 1957.
Project: 50 miles of 12-in. to replace partially looped 6, 8-in. line between Cunningham and Burton, Kans.
Status: To start as soon as pipe is received.
Completion: Late 1957.

• **Southern Kansas Pipeline, Inc.**
Project: 200 miles of 6 to 10-in. in Kans. from southwestern Meade County to 10 miles north of Arkansas City.
Status: Proposed. Request filed with Kansas Corporation Commission for permit.

• **Texas-New Mexico Pipe Line Co.** (Sinclair, Texas Co., Tidewater, Empire)
Project: 512 miles of 16-in. from southeast corner of Utah to Jal, N. M.
Status: To start October 15, 1957.
Contractor: **Four Way Co., Inc.**, has 150 miles from Aneth field southeast. **Panama, Inc.**, has remaining 362 miles.
Completion: 1958.

• **Toronto Pipe Line Co.**
Project: 20 miles of 4-in. gathering line in Munday area of Knox County, Tex.
Status: Under way.

U.S. Products Pipelines

• **Alaska-Yukon Refiners & Distributors, Ltd.**
Project: Two lines: one 150 miles from Haines to Haines Junction, Alaska, linking with government Canol line; another from Fok Junction, on Canol line, to Anchorage.
Status: Proposed.
Completion: 1959.

• **American Pipe Line Co.**
Project: Line from Gulf Coast to New York City. Has ODM approval to amortize 40 per cent of cost with fast writeoff.
Status: Proposed.

• **Buckeye Pipe Line Co.**
Project: Conversion of 32 miles of 8-in. between Mantua and Youngstown, Ohio.
Status: Planned.
Contractor: Company will do own work.
Completion: November 1957.
Project: 70 miles of 8-in. from Wayne to vicinity of Durand, Mich.
Status: Under way.
Completion: Early 1958.

• **Conn-Mass Pipe Line, Inc.**
Project: 62 miles of 8-in. and 7 miles of 6-in. from New Haven, Conn., to Springfield, Mass.
Status: Planned to begin in 1957.
Completion: April 1958.

• **El Paso Natural Gas Co.**
Project: 11 miles of 4-in. L.P.G. from Snyder Line to South Andrews Plant, Tex.
Status: Planned.
Project: 240 miles of 6-in. from Odessa to El. Paso, Tex.
Status: Under way.
Contractor: **McVean & Barlow, Inc.**, E. J. Miller, supt.
Completion: March 1, 1958.

• **Emerald Pipe Line Corp.**
Project: 120 miles of 6-in. from Sunray, Tex., to Tucumcari, N. M.
Status: Planned.
Completion: December 1, 1957.

• **Everglades Pipe Line Co.**
Project: 60 miles of 10-in. from Port Everglades, Fla., to Miami's International Airport and terminals south.
Status: Under way.

• **Florida Pipeline & Storage Co.**
Project: 67 miles from Everglades, Fla., to Homestead Air Force Base south of Miami.
Status: Under way.
Contractor: **Fish Service Corp.**
Completion: December 1957.

• **Gillette Pipeline, Inc. and A. W. Hartwig, Inc.**
Project: A 103-mile line from Dead Horse Creek field to Casper, Wyo.
Status: Has applied for permit from Wyoming Public Service Commission.

• **Great Lakes Pipe Line Co.**
Project: 93 miles of 8-in. from south of St. Paul to Eau Claire, Wis.; 68 miles of 12-in. from Great Lakes intersecting point with Badger Pipe Line to Chicago.
Status: Under way.
Contractor: **R. H. Fulton & Co.** has the 8-in. **Midwestern Contractors, Inc.**, has 20 miles of 12-in. in Chicago area and **M-R Co.** has 48 miles of 12-in. from Badger system east.
Completion: Late 1957.
Project: 15 miles of 6-in. from Lincoln, Neb., to Lincoln air base.
Project: 140 miles of 8-in. from Minneapolis to Superior terminals.
Status: Under way.
Contractor: **Laco Pipeline Contractors, Inc.**
Project: 14 miles of 8-in. from Coffeyville to Independence, Kans., replacing 4-in. line.
Contractor: **Jess Whitlow Pipe Line Service.**
Project: 11 miles of 8-in. from 10 miles east of Donahue, Iowa, to terminals at Bettendorf, Iowa.
Contractor: **R. T. Perry Pipe Line Construction.**

• **Laurel Pipeline Co.** (Gulf Refining Co., Sinclair Pipe Line Co., The Texas Co.)
Project: 100 miles of 24-in. and 340 miles of line graduating down to 14-in. at the west terminus, from Philadelphia to Cleveland.
Status: To start early 1958.
Completion: 1958.

Pipeline Patrol

• **Leonard Refineries, Inc.**
Project: 43 miles of 6-in. from Alma to Lansing, Mich.
Status: Planned.
Completion: Late fall 1957.

• **Northwest Pipeline Corp.**
Project: 80 miles of 8-in. and 300 miles of 10-in. products and crude line from Four Corners area to Salt Lake City.
Status: Proposed.

• **Ohio Oil Co.**
Project: 350-miles of 12-in. from Wood River, and Robinson, Ill., to Chicago.
Status: Under way.
Contractor: **Panama-Williams Corp.** has 84 miles from Robinson to Champaign.
Completion: 1958.

• **Salt Lake Pipe Line Co.**
Project: 80 miles of 8-in. loops from Adams to Ontario, Ore.
Status: Under way.
Contractor: **Hallmac Construction Co.**

• **Trust Pipe Line Co.** (Cosden Petroleum)
Project: 138 miles of 6-in. from Hawley, near Abilene, to Wichita Falls, Tex.
Status: Under way.
Contractor: **Holder Construction Co.**
Completion: October 15, 1957.

• **Underground Storage & Exploration, Inc.**
Project: 393 miles of 12-in. L.P.G. line from Moundsville, W. Va., to Newark, N. J., plus 95 miles of 6, 8-in. laterals to Mauch Chunk, Pa., and to Philadelphia.
Status: Proposed.

• **Union Oil Co. of California**
Project: 815-mile line from Rifle, Colo., to Los Angeles refining area, to carry products from its Rifle shale-oil plant.
Status: Proposed.

U.S. Natural-Gas Pipelines

• **Arkansas Louisiana Gas Co.**
Project: A 300-mile line, plus gathering lines, from Tex.-La. coastal area to northern La., to connect with present system.
Status: Long-range plans.

• **Atlantic Seaboard Corp.**
Project: 6 miles of 26-in. from Petersburg to Moorefield, W. Va.
Status: Has temporary FPC approval.
Contractor: **Williams-Austin Construction Co.**
Completion: November 1957.

• **Carolina Pipeline Co.**
Project: 177 miles of 2, 3, 4, 6, 8, and 10-in. between Blacksburg and Camden, S. C.
Status: Under way.
Contractor: **Panama-Williams Corp.** and P. A. Buchanan have construction contract. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.

• **Central Hudson Gas & Electric Corp.**
Project: 46 miles of 10-in. from Albany to Kingston, N. Y.
Status: Under way.
Contractor: **Williams-Austin Construction Corp.**, O. L. Martin and Ralph Gaddy, supts., office at Catskill, N. Y.
Completion: December 1, 1957.

• **Cities Service Gas Co.**
Project: 8 miles of 16-in., 20 miles of 8-in., 20 miles of 6-in., and 20 miles of 4-in. field lines in Barber County, Kansas.
Status: Under way.
Contractor: **Vaughn & Taylor Construction Co.**

Project: 3 miles of 12-in., 8 miles of 10-in., 4 miles of 8-in., 8 miles of 6-in., and 37 miles of 4-in. field lines in Eureka Field, Okla.
Status: Under way.
Contractor: **Prairie Construction Co.**

Project. 64 miles of 6 to 30-in. in Leavenworth and Anderson counties, Kans., Cass County, Mo., and Oklahoma County, Okla.
Status: Planned.

Project: 75 miles of 30-in. from Independence to near Welda, Kan.
Status: Pending FPC approval.

• **Coastal States Gas Producing Co.**
Project: A 20-mile gathering system from the Rock Island area of Colorado County, Tex., to the United Gas Corp. system.

• **Coastal States Gas Producing Co.** and **Southern Coast Corp.**
Project: 45 miles of 2 to 10-in. in Bee County, Tex. to connect presently shutin fields with Texas Eastern Transmission Corp.'s system.
Status: Planned.

• **Coastal Transmission Corp.**
Project: 575 miles of 12, 20, 22, 24-in. main line and 414 miles of 2 to 14-in. gathering lines between McAllen, Tex., and Baton Rouge, La.
Status: Under way.
Completion: January 1, 1958.

• **Colonial Natural Gas Corp.**
Project: Two systems; one between Houston-Lake Charles area and Miami, Fla.; one in the Carolinas and Georgia.
Status: Proposed.

• **Colorado Interstate Gas Co.**
Project: 1957 program . . . 66 miles of 30-in., 40 miles of 34-in., 109 miles of 26-in., and 100 miles of 24-in. from Springfield, Colo., to Pueblo, Colo; 345 miles of 30-in. from Kit Carson, Colo., to Beatrice, Neb.; 50 miles of 22-in. from Laverne to Hooker, Okla.; 24 miles of 22-in. Panhandle field looping.
Status: Pending FPC approval. Has temporary approval for the 50 miles in Okla.

• **Eastern Shore Natural Gas Co.**
Project: 34 miles of 8-in. and 90 miles of 6-in. from connection with Transcontinental Gas Pipe Line Corp. in Maryland, across entire length of Delaware to Salisbury.
Status: Pending FPC approval.

• **East Ohio Gas Co.**
Project: 90 miles of 24-in., and 23 miles of 30-in. from Richfield to Summerfield, Ohio.
Contractor: **Sharman, Allen, Gay & Taylor, Inc.**, James Adams, spread superintendent, office at Wadsworth, Ohio. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.
Completion: November 1957.

• **Edison Securities Co.**
Project: 130 miles of 30-in. from San Joaquin Valley fields to Wilmington, Calif.
Status: Being contested by Southern California Gas Co., Southern Counties Gas Co., and Pacific Lighting Gas Supply Co.
Contractor: **Bechtel Corp.**

• **El Paso Natural Gas Co.**
Project: 81 miles of 18-in. and 13 miles of 20-in. from Panoma Plant, Gray County, to Dumas Plant, Moore County, Texas.
Status: Under way.
Contractor: **R. H. Fulton & Co. Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.
Completion: November 1, 1957.

Project: 177 miles of 20-in. from Sonora Plant, Sutton County, to Plains Plant, Yoakum County, Texas.
Status: Planned. Filed for FPC permit.
Completion: January 1958.

Project: 74 miles of 30-in. Permian-San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: January 1958.

Project: 216 miles of 6 to 34-in. and 533 miles of various size in Ariz., Tex., N. M.
Status: Filed for FPC permit.

Project: 47 miles of 30-in. from proposed Lindrith, N. M., plant to proposed Chaco, N. M., plant.
Status: Under way.
Contractor: **Foutz & Burnum Construction Co.**
Completion: 1957.

Project: 38 miles of various size line to make additional gas available at the McElroy-Wilshire plant near Crane, Tex.

Project: 500 miles of 34-in. from Twin Falls, Idaho to California border near Las Vegas, Nev.
Status: Planned.
Completion: September 1959.

Project: 131 miles of 4, 6, 8, 10, 12, 16, 18 and 20-in. gathering lines in Gray, Wheeler, and Collingsworth counties, Texas Panhandle.
Status: Under way.
Contractor: **R. H. Fulton & Co.**
Completion: 1957.

• **Houston Texas Gas & Oil Corp.**
Project: 702 miles of 24-in. from Baton Rouge, La., to Kissimmee, Fla.; 139 miles of 18-in. and 101 miles of 20-in. from Kissimmee to Cutler, Fla.; 642 miles of 3 to 18-in. sales laterals in Florida. Main line to join Coastal Transmission's proposed line from McAllen, Tex., to Baton Rouge.
Status: To start November 1.
Contractor: **Midwestern Constructors** has the 702 miles of 24-in.; **Harbert Construction Corp.** has remainder.
Completion: June 1958.

• **Iron Ranges Natural Gas Co.**, St. Paul
Project: 68-mile transmission line and 47 miles of laterals to supply towns on the Mesabi Iron Range, Minn.
Status: Application pending with FPC.

• **Kansas-Nebraska Natural Gas Co.**
Project: 61 miles of various size gathering line in Camerick field, Texas County, Okla.
Status: Approved.

• **Michigan Consolidated Gas Co.**
Project: 67 miles of 10 and 12-in. between Sears and Travers City, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.**, Floyd Huduall, supt., office at Cadillac.

Project: 60 miles of 10 and 12-in. between Muskegon and Ludington, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.**, jointly with **H. L. Gentry Construction**, Frank Morris, superintendent, office at Hart, Mich.

• **Midwestern Gas Transmission Co.**
Project: Will build main line from Portland, Tenn., to Canadian border near Emerson, Man.; 829 miles of 24-in., 109 miles of 16-in., 174 miles of 12-in., plus 648 miles of 3 to 18-in. extensions in Minn. and Wis.
Status: Application pending with FPC.

• **Mississippi River Fuel Corp.**
Project: 54 miles of 26-in. loops between Perryville, La., and Columbia, Ill.
Status: Under way.
Contractor: **Cape Construction Co., Inc.**
Completion: November 15, 1957.

• **Montana-Dakota Utilities Co.**
Project: 28 miles of 12-in. from Fallon County to Dawson County, Montana.
Status: Approved.

Project: 6 miles of 12-in. between Mandan and Bismarck, N. D.
Status: Has temporary approval.

Mountain Fuel Supply Co., Salt Lake City
Project: Extension of 12-in. line from Ogden to Logan and Brigham City, Utah.
Status: Has applied to Utah Public Service Commission.
Completion: Late 1957.

• **Natural Gas Pipeline Co. of America**
Project: 350 miles of 20 and 26-in. from Jack and Wise counties, Texas, to Fritch, Tex., plus a gathering system.
Status: Under way.
Contractor: **R. H. Fulton & Co.** has Red River crossing in northern Montague County. **Fulton & Brodie, Inc.**, has gathering system. **Eastern Pipeline Contractors** has 80 miles of 20-in. from Bridgeport, Tex., to Healdton, Okla. **River Construction Corp.** has 173 miles from Mountain View, Okla., to Fritch, Tex. **H. B. Zachry Co.** has 87

Pipeline Patrol

miles of 26-in. between Healdton and Mountain View, Okla.

Completion: January 1, 1958.

Project: 389 miles of 36-in. loops along its line from Beatrice, Neb., to Chicago, to take gas from proposed line of Colorado Interstate Gas Co., and 91 miles of 30-in. loops along parts of its main line.

Status: Application pending with FPC.

Project: 337 miles of 30-in. between Fritch, Tex., and Beatrice, Neb., and 59 miles of 36-in. between Beatrice and Joliet, Ill., along existing system.

Status: Pending FPC approval.

Completion: 1959.

• **New York State Natural Gas Corp.**

Project: 31 miles of 20-in. from Harrison to Woodhull, N. Y.; 10 miles of 12-in. from Stockbridge to Oneida, N. Y.

Status: Under way.

Contractor: **Harford Brothers,** has the 12-in., A. M. Harford and Robert Mann, superintendents. **Pavilion Pipe Line Corp.** has the 20-in.

Completion: October 15, 1957.

Niagara Mohawk Power Co.

Project: 196 miles of 2 to 16-in. transmission and distribution mains to service areas in central, eastern and northern New York.

Status: Planned.

Contractor: Various.

Completion: December 31, 1957.

• **North Carolina Natural Gas Corp.**

Project: 630 miles of 2 to 16-in. from near Mooresville, eastwardly across N. C.

Status: To start fall 1957.

Completion: Spring 1958.

• **Northern Natural Gas Co.**

Project: 160 miles of 2, 3, 6, 8-in. branch lines to serve 20 new communities on Aberdeen, S. D., line.

Status: Under way.

Contractor: **Troth Construction Co.**

Project: 73 miles of 20-in. from Savanna Creek to Pincher Creek fields in Alberta, Canada; 32 miles of 24-in. from Pincher Creek to Montana border; 1,100 miles of 26-in. from Montana into Minneapolis.

Status: Proposed.

Project: 365 miles of main line and 1,090 miles of branch lines to serve communities in Minn., Iowa, S. D., Nebr., Wis.

Status: Filed with FPC March 18, 1957.

Project: 85 miles of 24 and 30-in. loops between Sunray, Tex., and Sioux City, Iowa.

Status: Under way.

Contractor: **R. H. Fulton & Co.**

Completion: December 1957.

Project: 13 miles of 16-in. to replace existing 10-in. line in Hansford County, Texas.

Status: Has temporary FPC authority.

• **Northern Utilities Co.**

Project: 35 miles of 16-in. in Fremont-Natrona County, Wyo., area; 8 miles of 12-in. around Casper; 6 miles of 8-in. from Sand Draw gas field to Beaver Creek field; 12 miles of 6-in. from Beaver Creek field to the system servicing the Riverton-Lander area.

Status: Planned.

• **Offshore Gathering Corp.,** Houston.

Project: 364 miles in Gulf of Mexico off Louisiana: 60 miles of 24-in., 70 miles of 26-in., 234 miles of 30-in. (Dual line.)

Status: Application pending with FPC.

• **Ohio Fuel Gas Co.**

Project: 11 miles of 18-in. and 11 miles of 20-in. from Gibsonburg, Ohio to Toledo; and 30 miles of 24-in. looping from Pavonia to Attica, Ohio.

Status: Under way.

Contractor: **H. L. Gentry Construction Co.** has the 18 and 20-in.

Completion: Gentry work completed; remainder November 25, 1957.

Project: 152 miles of line in Ohio: 43 miles of 24-in. from Crawford Station to Utica; 18 miles of 24-in. from Pavonia Station to Line D; 6 miles of 20-in. from Mount Gilead to Claridon; 4 miles of 20-in. near Dayton; 4 miles of 20-in. near South Charleston; 7 miles of 16-in. near Springfield; 6 miles of 20-in. nnear Oberlin; 17 miles of 20-in. from Oak Hill to Symmes Station; 7 miles of 12-in. from Mount Sterling to Bloomingburg; 2 miles of 8-in. near Bellefontaine; 3 miles of 12-in. near Mansfield; 4 miles of 12-in. near Lakeville; 7 miles of 8-in. in Guernsey and Belmont counties.

Status: Under way.

Contractor: **O. R. Burden Construction Corp.** has completed 43 miles of 24-in. from Sugar Grove near Crawford station, to Utica, Ohio, and 27 miles of 20-in. south from Wellston.

• **Pacific Gas & Electric Co.**

Project: 138 miles of 34-in. looping of the Topock-Milpitas line.

Status: Under way.

Contractor: **Engineers Limited Pipeline Co.**

Completion: December 1, 1957.

Project: 5 miles of 16-in., 160 miles of 12-in., 8 miles of 6-in. from Corning to Eureka, Calif.

Status: Planned.

Contractor: **Engineers Limited Pipeline Co.** and **Alex Robertson Co.**

Completion: January 1, 1958.

Project: 13 miles of 12-in., 2 miles of 10-in. from Santa Cruz to Davenport, Calif.

Status: Planned.

Completion: October 1957.

Project: 1,300 miles of 36-in. from Alberta to San Francisco.

Status: Proposed.

Completion: 1960.

• **Pennsylvania Gas Co.**

Project: 23 miles of 10-in. in Erie County, Pa., 15 miles of 8-in. in Warren and Chautauqua counties, Pa., 30 miles of branch lines, several small distribution lines.

Status: Has FPC permit.

• **Peoples Natural Gas Co.**

Project: 4 miles of 10-in. between Altoona and Tyrone, Pa., to replace 6, 8, and 10-in.

Status: Planned.

Completion: October 18, 1957.

• **Permian Basin Pipeline Co.**

Project: 83 miles of 16-in. from its Spraberry station in Midland County, Tex., to tie in with Pioneer Gathering System, Inc. in northwestern Schleicher County, Tex.

Status: Under way.

Contractor: **Lone Star Constructors,** H. A. (Red) Wylie, supt.

Completion: November 1957.

• **Phillips Petroleum Co.**

Project: 30 miles of 3 to 8-in. in Moore, Hutchinson, Sherman, Hansford, and Gray counties, Tex., and in Texas County, Okla.

Status: Planned.

Contractor: Various.

Completion: January 1, 1958.

• **Piedmont Gas Co.**

Project: 78 miles of 2 to 8-in. extension off Trancontinental in North Carolina to serve Gaston, Lincoln, Catawba, Caldwell, and Burke counties.

Status: Has FPC approval.

• **Pioneer Gathering System, Inc.**

Project: 70 miles of mostly 16, 12-in. in Val Verde, Schleicher, Sutton counties, Tex.

Status: Under way.

Contractor: **R. H. Fulton & Co.**

Competion: Early fall 1957.

• **Southern Natural Gas Co.**

Project: 10 miles of 8-in. laterals in Napoleonville Field and Fort Jackson Field, La.

Status: Has FPC approval.

Completion: December 1, 1957.

Project: 32 miles of 6-in. from Chandeleur Sound area, Breton Island, La.; 7 miles of 8-in. and 5 miles of 10-in. from Main Pass area to Olga, La.; 9 miles of 8-in. from Bastian Bay Field to Fort Jackson Field; 7 miles of 8-in. laterals in Manila Village Field.

Status: Has FPC approval.

Completion: December 1, 1957.

Project: 14 miles of 24 and 26-in., 62 miles of 20-in., 48 miles of 16-in., 21 miles of 12-in., 14 miles of 10-in., and 51 miles of smaller lines in La.

Status: Pending FPC approval.

• **Spokane Natural Gas Co.**

Project: 400 miles of 1 through 24-in. distribution system at Spokane.

Status: Under way.

Contractor: **Hallmac Construction Co.**; L. Williams, supt., office at Spokane.

Completion: 1957.

• **Tennessee Gas Transmission Co.**

Project: 34 miles of 30-in. loop from near Lancaster to near Winchester, Ky.

Status: Under way.

Contractor: **Oklahoma Pipeline Construc-**

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tors, Gene Gohring, supt., office at Richmond.
Project: 10 miles of 24-in. loop near New Castle, Pa.
Status: Under way.
Contractor: **Harford Brothers Pipeline Contractors.**
Project: Triple 24-in. underwater crossing of Mississippi River near Greenville, Miss.
Status: Under way.
Contractor: **Pentzien, Inc.**, and **Collins Construction Co.**
Project: 71 miles of 26-in., 10 miles of 20-in., 16 miles of 16-in., and 10 miles of 12-in. gathering lines from near Kinder, La., southward to offshore fields in Gulf of Mexico.
Status: Under way.
Contractor: **Brown & Root, Inc.**
Completion: November 15, 1957.
Project: 556 miles of 30-in. from Mississippi Delta area south of New Orleans to Portland, Tenn.
Status: Pending FPC approval.
Project: 76 miles of 24-in. from Coudersport, Pa., to Hamburg, N. Y.
Status: Pending FPC approval.
Project: 163 miles of 30-in. and 101 miles of 26-in. from Portland, Tenn., to near Lancaster, Ky.; from Winchester, Ky., to Morehead, Ky.; from Catlettsburg, Ky., toward Broad Run, W. Va.; from New Wilmington, Pa., to Mercer, Pa.; and from Morehead, Ky., to Catlettsburg, Ky.
Status: Pending FPC approval.

- **Texas Gas Transmission Corp.**

Project: 20 miles of 18-in. near Bastrop, La.
Status: Under way.
Contractor: **Houston Contracting Co.**, W. H. Hayes, supt., office at Bastrop.
Completion: Fall 1957.

- **Texas Eastern Transmission Corp.**

Project: 17 miles of 8-in. and 3 miles of 4-in. from its 20-in. Baytown-Hankamer line to Alco-Mag field in Harris County, Texas.
Status: Has FPC approval.
Project: 140 miles of 30-in. between Kosciusko, Miss., and Uniontown, Pa., 105 miles of 30-in. between Opelousas, La., and Kosciusko, 22 miles of 14-in. supply line in La.
Status: Pending FPC approval.
Project: 667 miles of 30-in. from Kosciusko, Miss., to Uniontown, Pa.
Status: Under way.
Contractor: **H. C. Price Co.** (64 miles from Barton, Ala., to Mount Pleasant, Tenn.; 51 miles from Mount Pleasant to Gladeville, Tenn.; 52 miles from Gladeville to Tompkinsville, Ky.; 68 miles from Tompkinsville to Danville, Ky.; 63 miles from Danville to Owingsville; 46 miles from Owingsville to Wheelersburg, Ohio. Will use four spreads); **Williams Brothers Co.** (63 miles from Egypt, Miss., to Barton, Ala.; 64 miles from Berne, Ohio, to Uniontown, Pa.); **Houston Contracting Co.** (80 miles from Kosciusko to Egypt, Miss., M. L. Thompson, supt., office at Ackerman; 57 miles from Wheelersburg to Athens, Ohio, W. H. Hayes, supt., office at Oak Hill; 61 miles from Athens to Berne, Ohio, R. E. Thornton, supt., office at Chauncey).
Completion: Fall 1957.

- **Texas Illinois Natural Gas Pipeline Co.**

Project: 44 miles of 36-in. and 4 miles of 34-in. from south of Joliet, Ill., to Howard Street, west of Chicago.
Status: Under way.
Contractor: **Midwestern Constructors, Inc.**

- **Transcontinental Gas Pipe Line Corp.**

Project: 172 miles of 36-in., 68 miles of 30-in., 162 miles of 24-in., and 64 miles of smaller size loops from Tex. to N. J.
Status: Work in North Carolina under way.
Contractor: **Western Construction Co.** has 65 miles of 36-in. and 45 miles of 30-in. at scattered spots along system in S. C., N. C., Pa., and Va. Work will start in N. C., office at Winston-Salem.
Completion: December 1957.
Project: 110 miles of 36-in., 16 miles of 30-in., and 13 miles of 24-in. looping in S. Car., Ga., Ala., Miss., and La.
Status: Under way.
Contractor: **Sharman, Allen, Gay & Taylor, Inc.**, E. D. Singleton, superintendent.
Completion: November 1957.
Project: 57 miles of 30, 36-in. loops in La., Miss., Ala., Ga., S. C., and 247 miles of mostly 24 and 16-in. laterals in Tex. and La.
Status: Under way.
Completion: December 1957.
Project: 87 miles of 24-in. laterals, plus small gathering lines connecting seven Louisiana fields with the New Orleans area.
Status: Pending FPC approval.

- **Trans-Western Pipe Line Co.** (Warren Petroleum, Monterey Oil Co., J. B. Butler.)

Project: A line from Four Corners area to Calif. border.
Status: Proposed.

- **United Gas Pipe Line Co.**

Project: 18 miles of 12-in. from Lirette-Mobile line in Jackson County, south to Bayou Casottee industrial area east of Pascagoula, Miss.
Status: Filed for FPC permit.

- **Western Slope Gas Co.**

Project: 36 miles of 4-in. from Piceance Creek field in northwestern Colo., to Rifle, Colo.
Status: Under way.
Completion: October 1957.

Canadian Crude-Oil Pipelines

- **Act Oils, Ltd.**

Project: A 450-mile line from the Peace River region of northern B. C. to tidewater at Bella Coola, B. C.
Status: Request has been made for permit from the B. C. government.

- **B-A Alberta Pipe Line, Ltd.**

Project: 35 miles of 8-in. to connect Drumheller field, Alberta, with existing lines running to Edmonton.
Status: Pending approval.

- **Pembina Pipe Line, Ltd.**

Project: 100 miles of 3 to 12-in. gathering line in Pembina oil field, Alta.
Contractor: **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., T. Childress, spread superintendent, office at Drayton Valley, Alta. Grand Cheinier, La., and Forest Oil Co.'s
Completion: November 1, 1957.

- **Royalite Oil Co., Ltd.**

Project: 250-mile line from Athabasca oil sands, northeastern Alta., to Edmonton.
Status: Long range plans.
Completion: 1960.

- **Westspur Pipe Line Co.**

Project: 20 miles of 12-in. from Alida in southeastern Saskatchewan, to the Carnduff-Glen Ewen area to tap Cantal, Hastings Florence, Carnduff, and Glen-Ewen fields 34 miles of 4, 6, 8-in. gathering lines.
Status: Has requested permit from Board of Transport Commissioners.
Contractor: **Majestic Contractors, Ltd.**, Jeff Minter, supt., office at Estevan, Sask.
Completion: No date set.

Canadian Products Pipelines

- **Hydrocarbons Pipeline Co.**

Project: 800 miles of 6 and 8-in. L.P.G. line from near Edmonton, Alta., to Port William, Ont.
Status: Has permit from Parliament of Canada. If approved by Federal Board of Transport Commissioners and the Alberta Petroleum and Natural Gas Conservation Board, work will start in 1957.
Construction consultants: **Dutton-Williams Brothers, Ltd.**, and **A. D. Little Co.**

Canadian Natural-Gas Pipelines

- **Alberta Gas Trunk Line Co., Ltd.**

Project: 637 miles of 34 to 16-in. gathering lines in Alberta.
Status: Under way.
Contractor: **Dutton-Williams Brothers, Ltd.** has preliminary studies, design and management-engineering. **Universal Pipe Line, Ltd.** subsidiary of Mannix, Ltd., jointly with **Marine Pipeline & Dredging Co.**, has crossing of Red Deer River near Cavendish, Alta., J. Hysuick, spread superintendent, office at Empress. **Fulton Banister, Ltd.**, has completed 17 miles of 34-in. west from Burstall, Sask., to near Cavendish, Alta., and 100 miles of 18-in. north to Bindloss and Provost fields.

- **North Canadian Oils, Ltd.**

Project: 47-mile extension into Jasper, Alta., of its 10-in. line from Wabamun to Hinton west of Edmonton.

- **Northern Ontario Pipe Line Crown Corp.**

Project: 675 miles of 30-in. from the Ontario-Manitoba border to near Kapuskasing, Ont. (part of the 2,250-mile Trans-Canada line; will be leased to Trans-Canada Pipe Line Co. with option to buy.)
Status: 79-mile section from Stedman to Forham Township under way.
Contractor: **Dutton Williams Brothers has** 58 miles from the Manitoba-Ontario border west of Kenora to a point east of the crossing of Ontario Highway 17. **Morrison Shivers, Ltd. has** 94 miles from the east crossing of Highway 17 to a line separating the townships of Hyndman and Hodgson. **Majestic Contractors, Ltd.**, and **Nelen, Ltd.**, have 80 miles from the Morrison Shivers terminal to Stedman Township. **Houston Contracting Co.** has 79 miles from Stedman to Forham Township, R. L. Silar, supt., office at Raith, Ont. **River Construction Corp., has** Winnipeg River crossing near Kenora, Ont. to complete November 15, 1957.
Completion: End 1957.

- **Provo Gas Producers, Ltd.**

Project: 22 miles of 3 to 12-in. gathering lines and wellhead tie-ins in Provost Field, Alta.
Status: Under way.
Contractor: **Fulton Banister, Ltd.**, Jim Boyce, supt., office at Consort.

- **Quebec Natural Gas**

Project: 34 miles of 16 to 24-in. across center of Island of Montreal.
Status: Under way.
Completion: November 15, 1957.

- **Trans-Canada Pipe Lines, Ltd.**

Project: 310 miles of 20-in. from Toronto to Montreal, 33 miles of 24-in. from Toronto to Niagara, N. Y.
Status: Under way.
Contractor: **Oklahoma Pipe Line Constructors** (83 miles of 20, 24-in. between Toronto and Montreal, and between Toronto and Niagara, N. Y.); **Grayco Constructors, Inc.** (120 miles of 20-in. between Toronto and Montreal). **Dutton Williams Bros.** (114 miles between Toronto and Montreal).
Completion: Late 1957.
Project: 82 miles of 30-in. from near Winnipeg to the Ontario-Manitoba border.
Status: Under way.
Contractor: **Majestic Contractors, Ltd.**, K. B. Killingsworth, spread superintendent, office at Ste. Anne, Man.
Completion: October 15, 1957.

- **Union Gas Co. of Canada, Ltd.**

Project: 142 miles of 26-in. from Dawn Township to Hamilton, Ontario, plus 55 miles of 6 to 20-in. laterals, and 317 miles of 2 to 12-in. distribution lines.
Status: Under way.
Contractor: **Canadian Bechtel, Ltd.** has the 26-in. line, to complete November 15, 1957, office at Galt, Ont.
Completion: November 30, 1957.

- **Westcoast Transmission Co., Ltd.**

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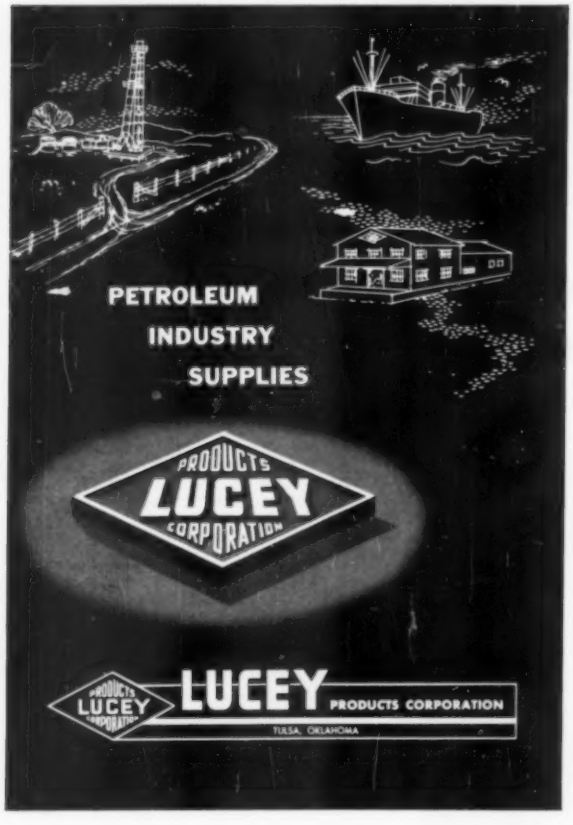
Project: 42 miles of 20-in. and 100 miles of 30 in. from Savanna Creek area, Alta., to Canadian-Idaho border.
Status: Planned.
Completion: November 1, 1958.

Foreign Crude-Oil Pipelines

- **Bolivian Gulf Oil Corp.**
  Project: 160 miles of 10-in. and 45 miles of 8-in. from Sicasicia to Arica on the Chilean coast.
  Status: To start late 1957.
  Contractor: **Williams Brothers Co.**
  Completion: 1958.
- **Bolivia-Paraguay**
  Project: 500 miles of 6-in. from Southeast Bolivia to a proposed refinery on Paraguay River, and later to Asuncion.
  Status: Planned.
  Contractor: Five Lilles, a French Combine.
- **Burmah Oil Co., Ltd.**
  Project: 850 miles of 20-in. from Nahorkatiya to Calcutta, India.
  Status: Survey under way.
  Contractor: **Collins Construction Co.** is surveying locations for some 40 river crossings.
- **Caltex**
  Project: 30 miles of 30-in. from Duri field in Sumatra to Dumai where a deepwater terminal will be built. Line will be extended 35 miles to Minas field later.
  Status: Planned.
  Completion: Duri-Dumai line to be finished in 1959; extension to Minas later.
- **Colombian Petroleum Co.**
  Project: 42 miles of 6-in. from Tibu field to Rio de Oro in Colombia.
  Status: Under way.
- **C.R.E.P.S., Societe Nationale de Recherche et d'Exploitation des Petroles en Algerie (SN Repal), and Cie. Francaise des Petroles Algerie**
  Project: Two 10-in. lines from Hassi Messaoud and Edjele, Algeria to the railhead at Touggourt.
  Status: Planned.
  Completion: 1958.
  Project: 450 miles of 16-in. from Edjele field in southeastern Algeria to a Mediterranean port on the Libyan coast.
  Status: Pipe has been ordered.
- **Creole Petroleum Corp.**
  Project: 87 miles of 30-in. from Temblador field to Caripito in Venezuela.
  Status: To start work early 1958.
  Contractor: **Pipe Line Engineering Co.** and **Oklahoma Pipe Line Constructors.**
  Completion: April 1958.
  Project: 9 miles of 26-in. from Ule to La Salina in Venezuela.
  Status: Planned.
  Completion: Late 1957.
- **Deutsche-Shell A.G.**
  Project: 120 miles of 20, 24-in. from Marseilles, France, to Rotterdam, Germany, to tap the 700 mile trans-Europe line proposed by the Royal Dutch-Shell Group.
  Status: Planned.
  Completion: 1960.
- **Iraq Petroleum Co.**
  Project: About 600 miles of up to 40-in. from Kirkuk field through Iraq to Turkish port of Iskenderun on the Mediterranean.
  Status: Proposed. Survey completed.
- **Mene Grande Oil Co.**
  Project: 97 miles of 30-in. from fields in Eastern Venezuela to Puerto La Cruz.
  Status: Under way.
  Contractor: **Fulghum Contracting Corp.** has 22 miles between Oficina and Anaco.
  Completion: First quarter 1958.
  Project: 45 miles of 24-in. from Oficina to Melones, Venezuela.
  Status: Planned.
  Completion: First quarter 1958.
- **Middle East Pipeline**
  Project: 1,500 miles of 38 and 40-in. line from Persian Gulf to Mediterranean at Iskenderun, Turkey.
  Status: Proposed.
- **National Iranian Oil Co.**
  Project: A 1,000-mile 38-in. line to move Qum crude to the Mediterranean.
  Status: Transit agreement approved.
- **North-West Oil Pipeline Co.** (newly formed by six West German refiners, headed by affiliates of Standard Oil Co. (N.J.), and British Petroleum Co., Ltd.)
  Project: 230 miles of 28-in. from refining centers in the industrial Ruhr area of West Germany to Wilhelmshaven.
  Status: Work to start early 1958.
  Completion: November 1958.
- **Royal Dutch-Shell**
  Project: 700-mile line across Europe from the Mediterranean to the North Sea, running through Eastern France, Luxembourg, West Germany, and Netherlands, and Belgium. Main trunk to be 30-in.
  Status: Company is considering project together with several other companies.
- **Standard-Vacuum Petroleum Maatschappij.**
  Project: 94 miles of 8-in. from Lirik field, Central Sumatra, to deep-water terminal on Siak River, near Buatan. A 3-in. hot-water "defroster" line will be laid under the 8-in. to heat the heavy crude.
  Status: Under way.
  Completion: Late 1957.



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   —Lists principal systems with location of home offices.
   —Shows refinery locations.

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Pipeline Patrol

• **Ste. Nationale de Recherche et d'Exploitation des Petroles en Algerie**

Project: Line in Sahara Desert area to move oil from Hassi Massaoud field. Two routes possible: 200 miles from the field northwest to Laghouat; 260 miles from the field to the north and slightly east to Biskra.

Status: Under study.

• **Union of Soviet Socialist Republic**

Project: 2,300-mile Trans-Siberian crude-products line from Ufa Tuimaza fields in Bashkiria to Irkutsk near Lake Baikal.

• **Yacimientos Petrolliferos Fiscales (Argentina)**

Project: 932 miles of 12-in. from Campo Duran to San Lorenzo.

Status: Planned.

Contractor: **TIPSA** (Fish Engineering Corp., Fish Northwest Constructors, Inc., Clark Brothers, North American Utility, Construction International Co.).

Project: 625 miles of 12-in. from Mendoza to San Lorenzo.

Status: Planned.

Foreign Products Pipelines

• **Empresa Nacional de Petroleos (Government of Chile) and Cia. de Petroleos de Chile (Copec), et al.**

Project: 75 miles of 10-in. from Chile's coastal refinery at Concon to Santiago.

Status: Under way.

Contractor: **Williams Brothers**

Completion: Early 1958.

• **Israeli Government**

Project: A 6-in. line from the Haifa refinery to Tel Aviv.

Completion: Late 1957.

• **Mene Grande Oil Co.**

Project: 60 miles of 6-in. L.P.G. line from Anaco to Puerto La Cruz, Venezuela.

Status: Planned.

Completion: Fourth quarter 1957.

• **North Atlantic Treaty Organization**

Project: 2,000 miles of lines to airfields in parts of Europe.

Status: Under way.

Contractor: **Associated Pipeline Contractors, Inc.** (450 miles from Iskenderun, Turkey to Batman); **TECHINT** (205 miles of 4-in. from Bandirma to Eskisehir, Turkey, and 250 miles of 8-in. from Antalya to Eskisehir).

Foreign Natural-Gas Pipelines

• **Attock Oil Co.**

Project: 60 miles of line from Dhulian field to Rawalpindi in West Pakistan.

Status: Planned.

• **Cuban Gas Transmission Co.**

Project: 650-mile pipeline from Campeche area of Mexico across Yucatan and on the ocean floor to Havana, Cuba; 150 miles would be submarine.

Status: Being studied by Ebasco Services.

• **Gaz de France**

Project: 550 miles of 16 to 24-in. from Lacq field, southwestern France, to Paris plus a 10-in. lateral to Nantes and 12 to 16-in. laterals to Lyons, making a 1,000-mile system.

Status: Under way.

Contractor: French contractors.

Completion: First stage in 1958; complete system in 1960.

• **NIOGAS**

Project: 160-mile, 6, 8, 10, and 12-in. line from Fischamend field to Vienna and other Austrian cities.

Status: Under way.

Contractor: **Williams Brothers and Costain-John Brown.**

Completion: Fall 1958.

• **Petroleos Mexicanos**

Project: 130 miles of 22-in. to parallel a 14-in. line from Reynosa to Monterrey.

• **Sui Gas Transmission Co.**

Project: 217 miles of 16-in. from Sui gas field to Moultan, Pakistan.

Status: Under way; to be extended later to Lahore with branches at Kot Addu, Jhang Magiana, and Montgomery.

Contractors: **Pakistan Constructors,** a joint company of **Morrison-Knudsen** of Boise, Idaho, and **William Press, Ltd.,** of London.

Project: 145-mile line from Sylhet to Dacca, East Pakistan.

Status: Under consideration. If approved construction could start December 1958.

• **Technical Office of Hydrocarbon, Ministry of Mines and Petroleum, Government of Venezuela.**

Project: 207 miles of 26-in. from Anaco fields to Caracas.

Status: Under way.

Contractor: **Fulghum Contracting Corp.** will be consultants; **Petrogas, S. A.** will engineer and construct the line.

Completion: Spring 1959.

• **Union of Soviet Socialist Republic.**

Project: 808 miles of 26-in. from Stavropol in the Northern Caucasus to Moscow, to serve Voroshilovgrad, Voronezh, Tula, Yelets, and Serpukhov.

• **Yacimientos Petrolliferos Fiscales (Argentina)**

Project: 1,015 miles of 24-in. from Camp Duran to Buenos Aires.

Status: Planned.

Contractor: **TIPSA** (Fish Engineering Corp., Fish Northwest Constructors, Inc., Clark Brothers, North American Utility, Construction International Co.).

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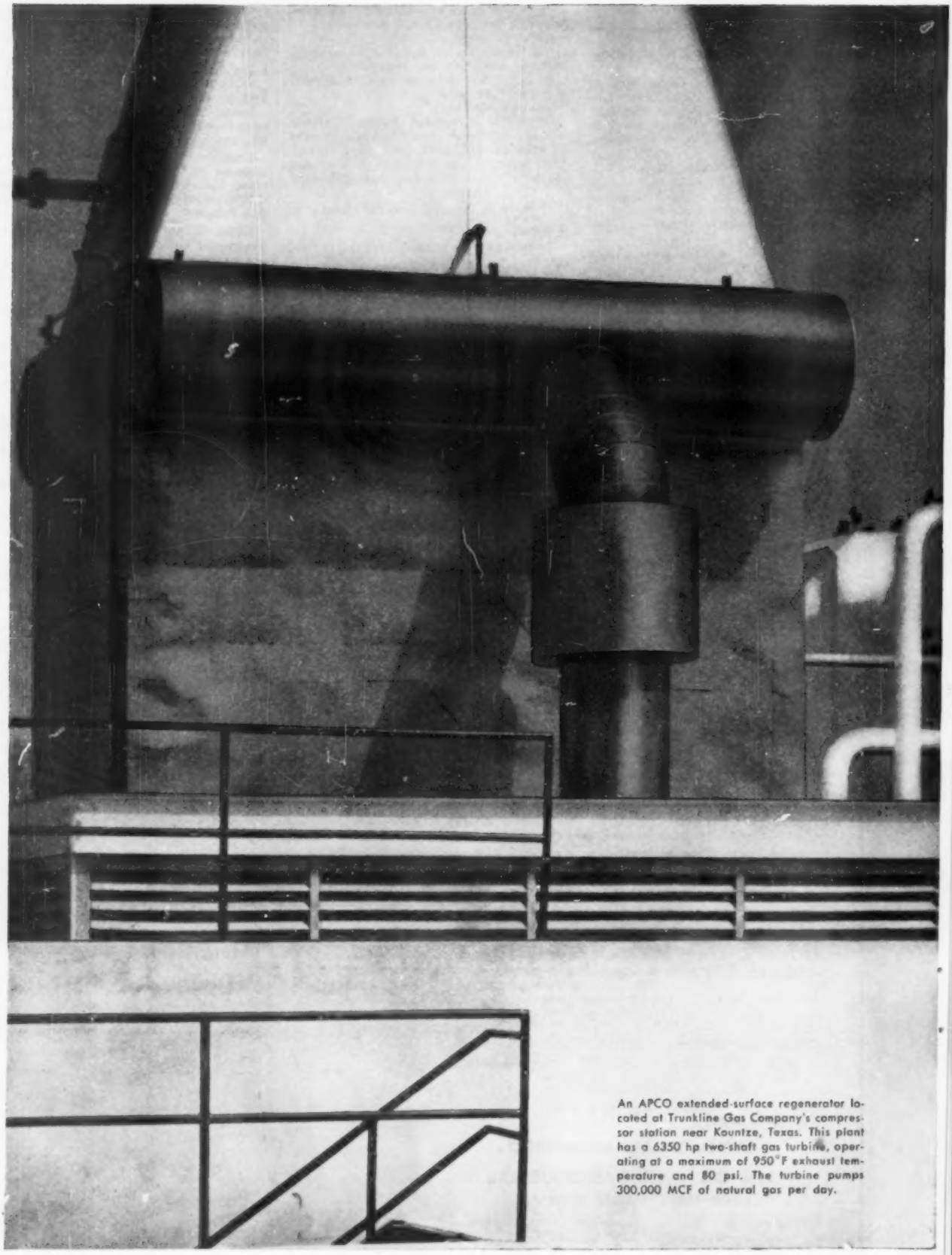

An APCO extended-surface regenerator located at Trunkline Gas Company's compressor station near Kountze, Texas. This plant has a 6350 hp two-shaft gas turbine, operating at a maximum of 950°F exhaust temperature and 80 psi. The turbine pumps 300,000 MCF of natural gas per day.

with pipeline costs soaring...

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Be sure to investigate the advantage of an APCO extended-surface regenerator, if you are considering gas turbines. For details of their labor saving efficiency, write Air Preheater Corporation . . . better yet, call and arrange for our engineers to sit down with yours.

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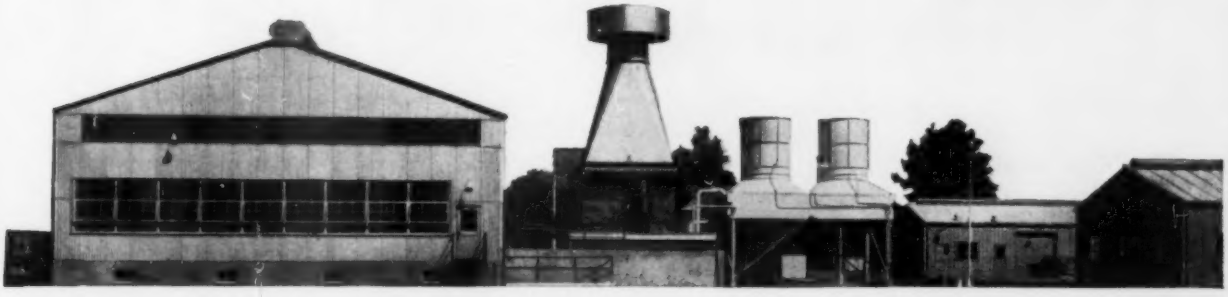

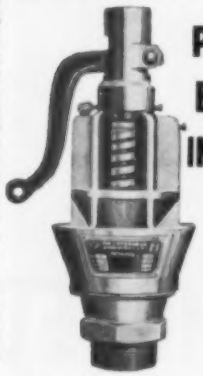

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Box 1260 Tulsa, Okla.

Among the
Drilling Contractors

Gracey-Heliums has an 11,500-ft. contract for Union Oil Co. of California at Lake Hatch field in Terrebonne Parish, South Louisiana. The B-20 LL&E will be drilled in 4-18s-16e.

Bankhead Drilling Co. will have contract for a 12,500-ft. wildcat in Plaquemines Parish, South Louisiana, for Texas Gas Exploration Corp. The 1 Smith-State Lease Un 2624 will be drilled in 29-20s-29e.

Beck Oil Co. has contract for an 8,800-ft. wildcat in Beauregard Parish, South Louisiana. The well will be Kilroy Co. of Texas 1 Lutcher-Moore Lumber Co. in 31-5s-11w, 3 miles north of Bearhead Creek field.

Gulf Coast Drilling Co. of Louisiana has contract for an 11,000-ft. wildcat in Plaquemines Parish, South Louisiana, for J. J. Rebstock-R. H. Reeves at 1 Rebstock-Reeves-De Armas. Location is 54-20s-18e, 2½ miles west of Grand Bay field.

Trant Drilling Co., Tyler, Tex., has taken on two more deep-drilling jobs in East Texas. One is an 11,500-ft. test for Humble Oil & Refining Co. in southern Nacogdoches County. The other is a 10,000-ft. test for Seaboard Oil Co. in northern Henderson County. Humble's job is at 1 Mast, in the T. J. Lambert Survey. It is 10 miles southeast of Douglas. Seaboard's test is 4½ miles southwest of Brownsboro at 1 Lewis, in the J. D. Liverman Survey.

Love-Miller Drilling Co., Inc., Denver, is drilling for Stuarco Oil Co. at a wildcat location in southwestern Logan County, northeastern Colorado. Location is 18 miles southwest of Sterling. It is near the Weld County line, in 18-7n-55w.

Thrasher Drilling Co., Shreveport, has a rig working for Hunt Oil Co. at a wildcat location about 2 miles northeast of Muddy Bayou field, in LaSalle County, Central Louisiana. It is a 5,500-ft. Wilcox test, now near its objective. Location listing is H-132 Louisiana Delta, in 12-5n-4e.

Falcon Seaboard Drilling Co., Tulsa, will handle contract for a Comanche County, Southwest Kansas wildcat, for Gulf Oil Corp. The 5,150-ft. Gallup-Robbins is a Mississippian try in C SW NE 6-31-16. Location is 1 mile south of Glick field and 6 miles northeast of the town of Willmore, Kansas.

Petersen Petroleum Corp., Shreveport, is on a contract job 2 miles south of Harrisonburg, in Catahoula County, East-Central Louisiana. It is a 5,000-ft. Wilcox test for Douglas Whitaker and Marlin Exploration, Inc., also of Shreveport. Location is listed as 1

TIME OUT on the ultra-deep test Big Chief Drilling Co., Oklahoma City, is drilling for Magnolia Petroleum Co. in the West Cement area of Caddo County, Oklahoma. Left to right: Dick Clements, Magnolia drilling foreman; Dan May, Big Chief tool pusher; T. B. Moffit, John Underwood, Elmer Pendley, Hoyt Underwood, and P. Nottenkamper (driller), Big Chief's daylight drilling crew; Al Stennett, Magnolia geologist; and Marice Howell, Barold mud engineer. The test, 1 Sterba, is drilling near 20,400 ft.

Thomas-Taliaferro et al, with spot in 26-9n-6e. It is about 2¾ miles north of Tew Lake field, nearest production.

Roden & McRae Drilling Corp., Casper, Wyo., is under contract to Great Lakes Oil & Chemical Co. for a 5,500-ft. test at a wildcat location in the Pomeroy Ranch area, southeastern Lincoln County, western Wyoming. Location is about 8 miles southeast of Labarge in 21-24n-113w. It is Great Lakes' 41-21 "C" Unit.

Parker Drilling Co., Tulsa, has contracted with Gulf Oil Corp. for a 7,300-ft. test in Logan County, western Arkansas. Location is 7 miles northeast of Paris and about 5 miles southeast of Denning. It is 6 miles southeast of Aetna field, nearest production. Spot is in 13-8n-26w, on Gulf's Hempree lease.

Sunnyland Contracting Co., Rayne, La., has contracted for a 5,000-ft. Eutaw test 1½ miles northeast of East Yellow Creek field, in Wayne County, Mississippi. Ralph Stanley and R. Merrill Harris, the operators, have their location in 33-10n-7w, on their Atkinson lease.

Perry Well Servicing Co. is getting well down on a Wilcox test it is drilling for Larco Drilling Co. and G. G. Stanford in Jefferson County, southwestern Mississippi. Its location, at 1 Bailey Heirs, in 23-9n-2e, is just north of Stonington. Nearest Wilcox production is at Fayette, 7 miles west. Contract is for 6,000 ft.

Conway-Tanner Drilling Co. has a new contract job in Clay County, northwestern Mississippi. It is a 6,000-ft. Paleozoic test. Location, at 1 Brownlee, in 22-15s-5e, is 13½ miles northwest of West Point. It is about 5 miles southeast of Trebloc field, and about 6 miles west of Muldron field. Operator is L. O. McMillan, of Dallas.

Brewster-Bartle Drilling Co., Houston, has contracted with Sun Oil Co. for a deep test 2½ miles southeast of Little Lake field, in the coastal marshes of Jefferson Parish, Louisiana. Location is about the same distance northwest of South Little field. It is on an L. L. & E. Co. lease in Township 18s-23e.

Slim Hole Drilling Co., Houston, has a rig working for Beck Oil Co. in the new south extension area of Humble field, 2 miles southeast of Humble, in northern Harris County, Texas Gulf Coast. It now is on 1 Britton and others, a 6,200-ft. contract, in the W. Williams Survey.

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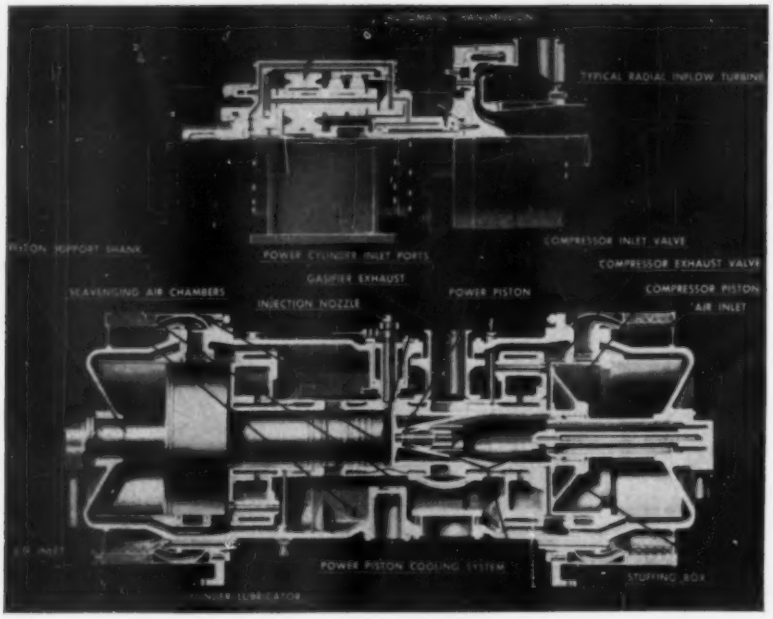

Free-Piston Engine Offers Many Uses

A number of applications are possible for the pneumatic power supplied by this new FP-165 free-piston engine, according to the maker. The pneumatic power can be easily converted into shaft power through a turbine to provide easily controlled variable speed, high starting torque, and direct reversibility of shaft rotation—features not readily obtainable with crankshaft type of engines.

Or the pneumatic power can be used directly, without using a turbine to produce shaft power, to pressure feed preheated air to boilers for increased steam plant efficiency and to generate pressured air to operate compressed-air-driven tools. Besides these features, the free-piston engine is adaptable to a wide range of fuels, the maker reports.

The FP-165 is a two-stage compression unit which produces 250 shaft horsepower with turbocharging and 125 hp. without turbocharging. **Write or call: Baldwin - Lima - Hamilton Corp., Hamilton, Ohio., for details on FP-165 free-piston engine.**

●

Pipeline Joint Wrap Features Increased Strength

Increased tensile strength in both the longitudinal and the horizontal directions is offered by this new glass-fabric-base pipeline-joint wrap, the maker states. Known as Duratape, the wrap consists of a woven-glass-fabric base, heavily coated on each side with either a coal tar (Type W-711) or asphalt covering (Type W-712).

The improved product has a tensile strength of 120 lb. per lineal inch for the width dimension, an increase of 20 times its former rating, according to the maker.

Highly resistant to electrolytic currents which cause corrosion, the tape is designed for hand wrapping of field joints or fittings on underground pipelines. **Write or call: L-O-F Glass Fibers Co., 1810 Madison Avenue, Toledo, Ohio, for details on Duratape.**

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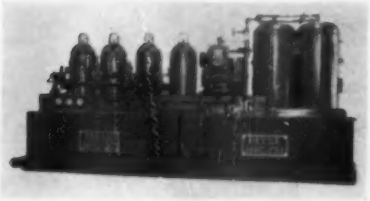
New Equipment

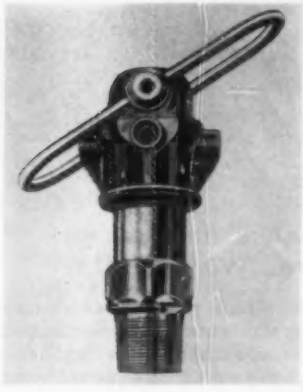


Blowout Preventer Unit Made in Large Size

The Payne nonseparator type of accumulator unit shown here is considered one of the largest ever built. It consists of two automatically controlled pumps, four 20-gal. nonseparator type of accumulators which operate without diaphragms or bladders, and four 11-cu.-ft. air receivers with a 5-hp. compressor.

A remote-control manifold for Hydril preventers is included. Bearings are specially sealed and lubricated for extreme low-temperature operation. **Write or call: Payne Mfg. Co., 7239 Canal Street, Houston, Tex., for details on nonseparator type of accumulator.**

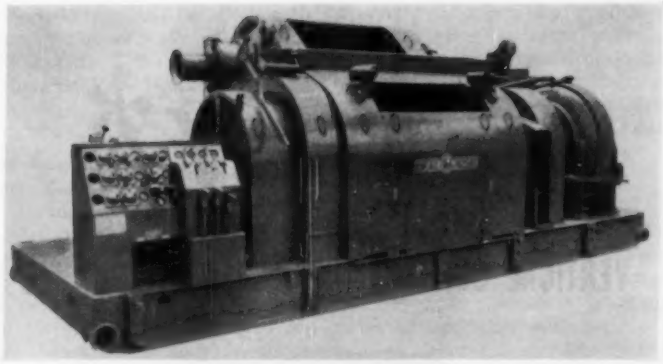
●



Wire-Line Oil Saver Permits Instant Release

Features offered by this new wire-line oil saver, the Type A Strip-Master, include quick-change rubbers, instant release and reset, a 3,000-psi. pressure test, and a leakproof body, the maker reports.

This unit slips over the sinker bar and rope socket. Its sturdy wrench lugs allow easy makeup to the well fittings. **Write or call: Bell Rubber Co., 5601 West Jefferson Blvd., Dallas 8, Tex., for details on Type A wire-line oil saver.**



Electric Rig Built for 25,000-Ft. Depths

Here's a new National drilling rig intended primarily for electric application. Identified as the Type 1625DE, the rig will be normally considered for drilling in the 16,000 to 25,000-ft. depth range, using 1⅜ or 1½-in. wire line, and using from 1,300 to 2,000 hp. delivered through electric-motor drives, according to the company.

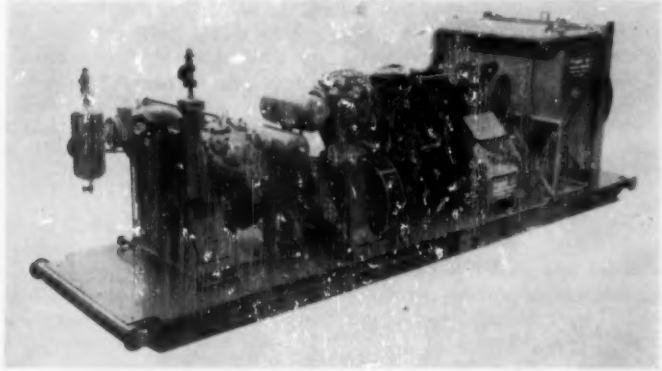
The draw works is basically of one-piece design. Set on a heavy 18-in. beam base, it has provision for a sand reel. A rear section accommodates the electric motors and the motor-drive portion of the draw-works transmission. It may be detached for transporting.

The rotary may be driven by a countershaft, accommodated on a small detachable front section of the draw-works base. Or it may be driven by an independent electric motor.

The transmission shaft carries two drives to the drum. These plus two additional drives on the primary shaft of the motor drive give four hoisting speeds. Two speeds are available to the catheads (and sand reel if one is used) and to the rotary drive.

The drum is 36 in. in diameter and 61¼ in. long. It permits hoisting 135-ft. stands of drill pipe with eight lines without spooling more than three full layers of line on the drum.

Power for the draw works is provided by two or three 625 to 650-hp. motors or two 1,000-hp. motors. These are coupled together on a separate skid which is aligned with and bolted to the rear of the main draw-works frame. **Write or call: National Supply Co., Two Gateway Center, Pittsburgh, Pa., for details on Type 1625DE rig.**



Air-Drilling Unit Uses Single Engine

A single engine powers two gas compressors on this heavy-duty portable air-drilling unit. And its compact design allows it to be transported well within road limitations, the maker states.

One twin-cylinder 200-hp. compressor is direct-connected to the engine. The other, a single-cylinder 100-hp. unit, is belt driven. The package unit will deliver 1,050 cu. ft. per minute of air at 125 psi. And through a special unloader, it will supply 650 cu. ft. per minute at 250 psi. **Write or call: McNamar Boiler & Tank Co., North Rockford and Frisco Tracks, Tulsa, Okla., for details on portable air-drilling unit.**

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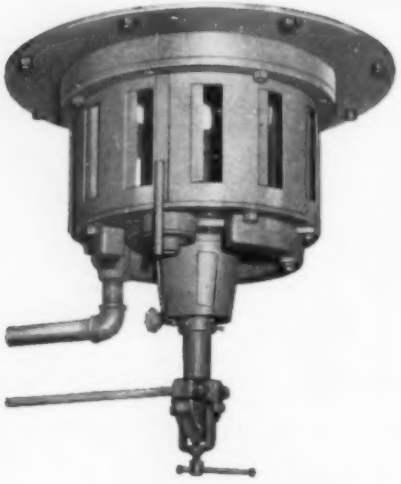

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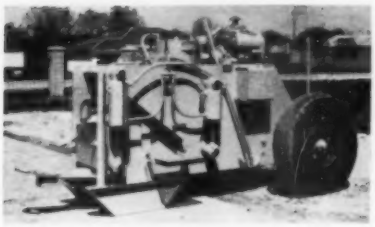


Bending Machine Handles 6 to 20-In. Pipe

Pipe in sizes from 6 to 20 in. can be bent readily with this new lightweight, portable Crose pipe-bending machine, according to the company.

Weighing about 8,400 lb. including the bend set, the machine is only 6 ft. 8 in. wide. It mounts on wheels equipped with 11 by 16 nylon desert-sand tires. **Write or call: M. J. Crose Mfg. Co., 2715 Dawson Road, Tulsa, Okla., for details on vertical pipe-bending machine.**

Moisture Analyzer for Cores, Works Fast

The amount of moisture in geological cores and other solids can be quickly determined with this new Schlumberger NMR high-speed moisture analyzer, the Model 104, according to the maker. It carries out the analysis in from 30 seconds to 4 minutes.

Operating on the principle of nuclear magnetic resonance, the instrument is both a research and a production instrument. Once calibrated, it can be operated by an unskilled technician, the maker states. Samples analyzed are not altered. Thus they are available for further tests or for return to stock. Sample size is 40 cc. A permanent legally valid chart recording of the analysis is provided. **Write or call: Schlumberger Well Surveying Corp., Ridgefield, Conn., for details on Model 104 moisture analyzer.**

New Literature

Plastic Pipe Fittings and Valve Brochure. This new illustrative brochure and stock catalog covering Sloane plastic-pipe fittings and valves includes data and illustrations on various plastic-pipe fittings. These include tees, ells, side-outlet ells, couplings, male adapters, female adapters, reducer bushings, nipples, clamp saddles, caps, plugs, and flanges. It also includes a detailed diagram and description of plastic valves. **Write or call: Sloane Mfg. Co., 7606 N. Clybourn Avenue, Sun Valley, Calif., for plastic pipe-fittings brochure.**

●

Wire Rope Abrasion is discussed in new two-color illustrated Leschen Bulletin 101. It describes the principal causes of this commonest and most destructive enemy of wire rope. And it lists numerous practical suggestions for minimizing abrasion. **Write or call: Leschen Wire Rope Div., H. K. Porter Co., Inc., 2727 Hamilton Avenue, St. Louis 12, Mo., for bulletin titled, "Abrasion."**

●

Air-Operated Valves. New Bulletin HB-6 gives the construction details and operating characteristics of Series HB Saunders valves. The eight-page booklet includes sizing data and a comprehensive listing of flow coefficients to aid in the proper valve selection. According to the bulletin, the valves incorporate a close-coupled design and are available in all sizes with diaphragm or cylinder actuators for on-off and throttling control. **Write or call: Conoflow Corp., 2100 Arch Street, Philadelphia 3, Pa., for Bulletin HB-6.**

●

New Power Transmission Data to Meet Modern Engineering Standards is given in this Ohio Gear 1957 handbook. It comprises 186 pages of power-transmission data compiled and revised to meet today's modern engineering standards and tabulations and calculated to plan the proper transmission for any drive. The catalog contains valuable engineering charts, tables, and formulas to help the designer select the right gears and speed reducers for the job. The gear section of the handbook, greatly expanded, tabulates complete dimensions on Ohio standard spur, bevel, spiral, helical, and worm gears and steel racks. The speed-reducer section gives the specifications, dimensions, and vital mechanical information necessary to select the proper reducer in relation to required ratios, horsepower, torque, and installation dimensions. **Write or call: Ohio Gear Co., 1333 East 179th Street, Cleveland, Ohio, for 1957 Handbook.**

●

Alkaline Rust Remover is set forth in this new illustrated four-page folder. Called Turco, the rust remover is a chemical compound said to remove rust, paint, and primer from metal surfaces in two simple steps without the use of acids. The product is said to eliminate six of the eight steps required by conventional methods of rust and paint removal. Parts being derusted by the new process are merely immersed in a hot solution and then rinsed. The compound strips slightly pitted rust in less than a minute, the maker claims. Heavy rust and multiple paint layers usually require only a few minutes. **Write or call: Turco Products, Inc., 6135 South Central Avenue, Los Angles 1, Calif., for folder on rust remover.**

●

Selector Switches for Temperature Measuring Circuits are described in new Thermo Electric Bulletin 24.1. It covers both key and push-button types for thermocouples or resistance-bulb circuits. According to the four-page bulletin, the switches provide a fast, convenient means of frequently checking many thermocouples or resistance bulbs switching them from one instrument to another, or switching one instrument to many different measuring points. Individual diagrams in the bulletin illustrate how each type is incorporated in the circuit. Also the bulletin gives pertinent information on the construction features and individual case capacities for thermocouple and resistance bulbs. **Write or call: Thermo Electric Co., Inc., Saddle Brook, N. J., for Bulletin 24-1.**

●

New Water-Flood Product called Fludex is described in this new illustrated Tretolite brochure. The brochure points out that one of the problems in water-flood operations is incompatability of certain treating agents often needed to correct simultaneous problems and goes into the need for a multipurpose injectivity stimulator. It also details what Fludex is and how it works. The product is said to be an excellent wetting agent which will condition the surfaces of a formation and permit faster and easier injection of water at lower operating pressures. And it is also described as an effective bacteriostatic agent for the control of sulfate-reducing organisms, corrosion inhibitor, and scale preventive. The brochure describes the application of the product to pumping wells having open casing in water-disposal and water-flood systems, and in backwashing of formations. **Write or call: Tretolite Co., 369 Marshall Ave., St. Louis 19, Mo., for brochure on Fludex.**

●

Metal Reinforced Plastic PVC Tubing called Bardex, that is said to have been flexed to an angle of 90° over 1½ million times without cracking or breaking and that will bend around a ⅜-in. diameter spindle without its internal bore being reduced is illustrated and described in a new two-color Newage leaflet. The leaflet explains that the tubing is weatherproof and resistant to gasoline, oils, high-octane fuels and sea water. The tubing has a working temperature ranging from 170° to —5° F. and working pressures ranging from 100 to 200 psi. **Write or call: Newage Industries, Inc., 222 York Street, Jenkintown, Pa., for data sheet on Bardex tubing.**

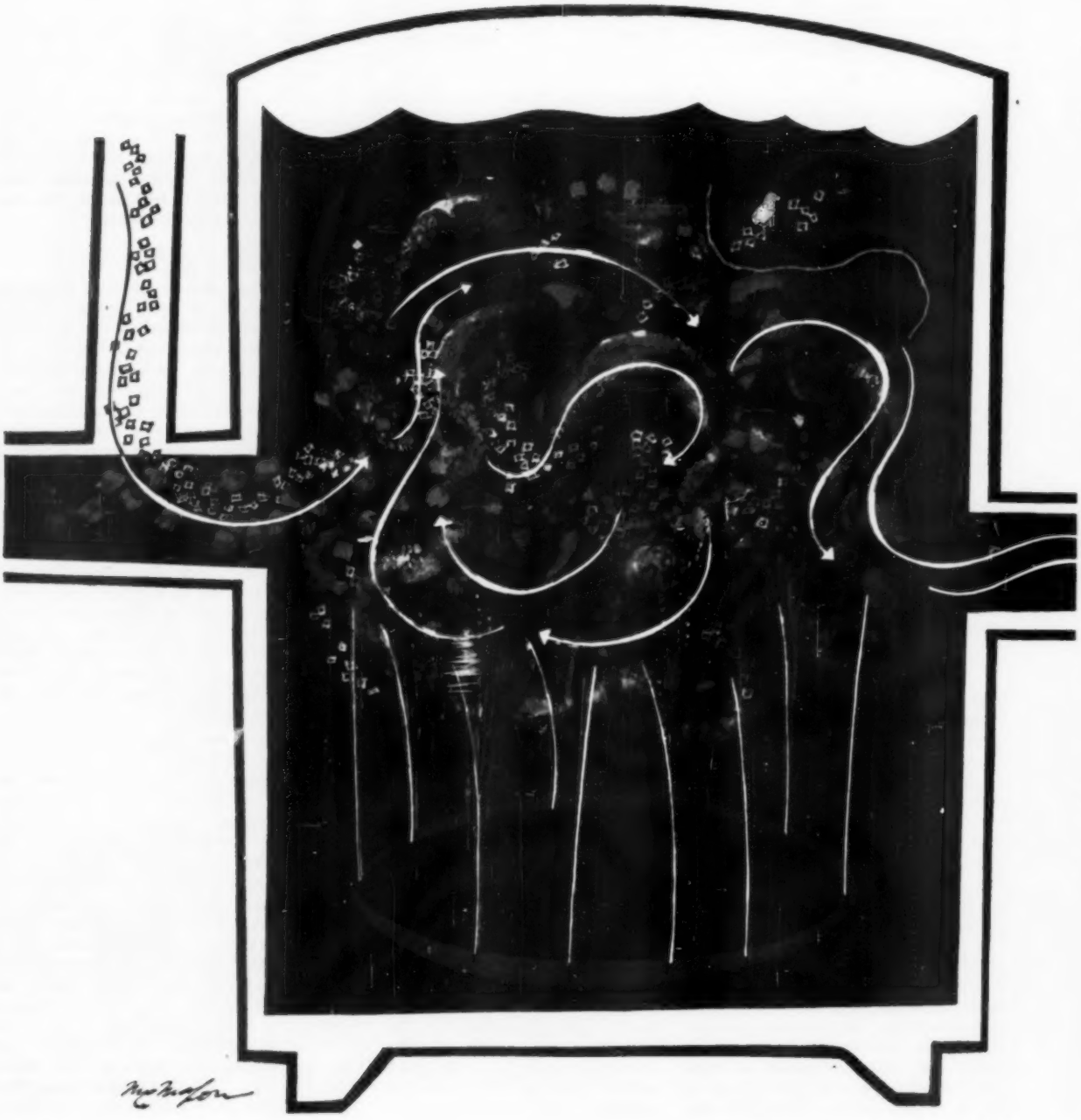
●

Rapid Operation of Offshore Platforms is described in new Bulletin 501-51. Containing 20 illustrations to show the outstanding features of LeTourneau offshore platforms, the brochure discusses in detail the size, capacities, and operational versatility of one specific unit, the Vinegarroon. This particular platform, it is explained, was delivered some months ago and already has achieved an outstanding record for versatility and efficiency. The 20 illustrations include drawings of the deck layout, below-deck facilities, progressive ocean-floor illustrations of the platform going on location, and numerous photographs of construction phases, living facilities, deck cranes, and other nondrilling equipment on board. **Write or call: R. G. LeTourneau, Inc., 2399 South MacArthur, Longview, Tex., for Bulletin 501-51.**

●

Gasoline Sweetening and Inhibitor Addition are covered in new Milton Roy Application Engineering Data Sheet E-57-1. It describes two systems for metering sweeteners, inhibitors, and metal deactivators to gasoline. The two-page data sheet shows how electric or air-operated controlled volume pumps are employed in these systems. And it illustrates methods for metering additives to individual storage tanks and for continuous proportional metering to product streams. Additionally, it includes complete specifications and equipment data. **Write or call: Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa., for Data Sheet E-57-1.**

Armour Organics Stop Sludge in Refinery Products



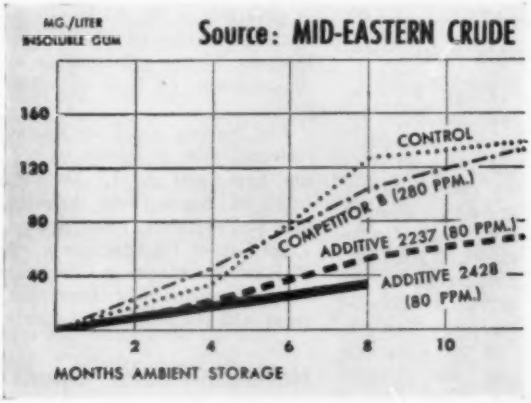
Here is a unique group of polar organic surface active chemicals that meet the toughest industry requirements for fuel additives. They can be important to you because:

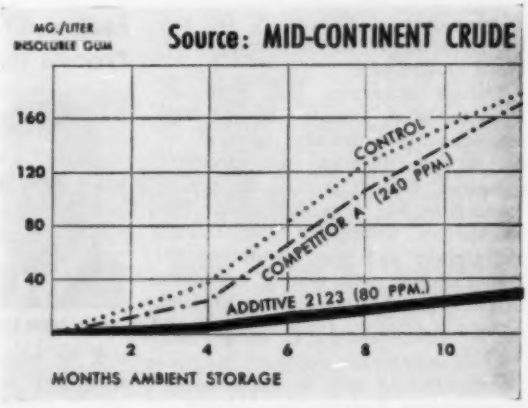
(1) Insoluble gums can now be effectively solubilized or inhibited for as low as *1¢ per barrel.*

(2) Filterability and color stability can be controlled to meet the strictest "specs." Unstable furnace oils, which previously caused filter plugging in burner operations and exhibited color degradation, are no longer a problem when Armour additives are used.

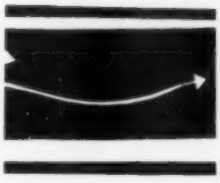
ARMOUR PRODUCTS EXCEL IN 12 MONTHS STORAGE TESTS

Four fuel oil stocks (West Texas, Mid-Continent, Venezuelan and Middle East types), have been subjected to 12 months ambient storage conditions using 41 potential additives. These 41 additives resulted from the screening of over 300 chemicals. Four Armour products (3 graphically shown below) were outstanding in their ability to inhibit and/or solubilize gum and stabilize against radical color change. In addition, most effective for West Texas crudes was Armour Additive #2528; for Venezuelan crudes, Additive #2237.





OTHER REFINERY APPLICATIONS



Even the most rigid specifications for stabilization and corrosion inhibition of gasoline, diesel and jet fuels can be met by adding Armour chemical additives.

Armour polar organic surface active agents have the innate ability to adsorb onto metal surfaces, rendering such surfaces hydrophobic. When used in lubricating oils and greases, this property, plus superior lubricity and corrosion protection, assures longer machine life. In addition, this adsorption characteristic also helps inhibit corrosion and fouling in operational equipment.

The Armour Chemical Division is ready to help you utilize the proper additive for your special situation. Let our trained staff assist you by recommending the Armeen® or Duomeen®, or one of their derivatives, specifically designed to solve your problem.

ARMOUR

Leader In Progressive Fatty Acid Chemistry

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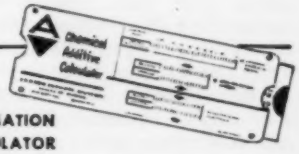


SEND FOR SAMPLES, INFORMATION AND FREE SLIDE RULE CALCULATOR

☐ Chemical additive "Slide Rule" Calculator.

Samples of _____
(Fill in chemical desired)

Applications information on _____

_____

NAME _____ TITLE _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

G-9

Armour Chemical Division • 1355 West 31st Street • Chicago 9, Illinois

EQUIPMENT MEN . . . in the News

Dresser Opens New and Expanded Zurich Offices

The formal opening of new and expanded offices was held recently in Zurich, Switzerland, by Dresser A. G., European subsidiary of Dresser Industries, Inc. Hosts for the Zurich opening were J. B. O'Connor, president of Dresser Industries, Inc.; Reece Hatchitt, president of Dresser A. G.; and Dr. Hans Berger, of the Dresser A. G. board of directors.

Dresser Industries, Inc., headquartered in Dallas, Tex., is a leading manufacturer of industrial equipment for the oil, gas, chemical, and electronic industries. Dresser A. G., the Zurich-based firm, has sales and service representatives throughout the Eastern Hemisphere and also coordinates the manufacturing and mining operations of Dresser Industries, Inc., in England, France, Germany, Holland, Italy and Greece.

Canadian Fairbanks-Morse Named Climax Distributor

The Canadian Fairbanks-Morse Co., Ltd., has recently been appointed Canadian distributor of Climax engines. This new affiliation gives Climax Engine Manufacturing Co. complete sales and service facilities throughout Canada.

Headquarters of Canadian Fairbanks-Morse are at Montreal, Que.; and main branches at Halifax, N. S.; Toronto, Ont.; Winnipeg, Man.; Edmonton, Alta.; and Vancouver, B. C. Subbranches are located at St. John, N. B.; Quebec City, Que.; Ottawa, Windsor, London and Fort Williams, Ont.; Saskatoon and Regina, Sask.; Calgary, Alta.; and Victoria, B. C.

Climax Engine Manufacturing Co., a division of Eversharp, Inc., has general sales offices at Chicago, a district office at Dallas, Tex., and a factory at Clinton, Iowa.

Pennzoil Names Osman as Ad, Sales Promotion Mgr.

Jack E. Osman has been named manager of advertising and sales promotion for the Pennzoil division of South Penn Oil Co., Oil City, Pa., He formerly was assistant director of advertising for Republic Steel Corp., Cleveland, Ohio.

Osman succeeds E. F. Johnson who will retire December 31 after 26½ years of heading the advertising activities of Pennzoil. Osman served 5 years with the company's advertising division in the late 1930's and early 1940's. He has since been with Bell Aircraft in Buffalo, Richfield Oil Corp. and its advertising agency, Hixson & Jorgensen, Los Angeles, and for the last 7 years with Republic Steel.

Beckman Names Newman to Process Instruments Post

F. J. NEWMAN

Frank J. Newman has been appointed as marketing manager for the process instruments division, Beckman Instruments, Inc., according to M. K. Howlett, division manager. Newman will be responsible for all sales and marketing activities of the division, which manufactures a broad line of continuous-operating analytical and control instruments for the chemical, petroleum and process industries. Headquartered at Fullerton, Calif., the division also operates research and manufacturing facilities in Stamford, Conn., and Ronceverte, W. Va.

Assuming this new post after 1 year as sales manager for the process instruments division, Newman joined Beckman Instruments in 1955 as a product line supervisor. Prior to that time, he served with Minneapolis-Honeywell Regulator Co.

Todd Finishes Pipe-Laying Barge for Brown & Root

The products division of Todd Shipyards Corp. has completed a large pipelaying barge for Brown & Root Marine Operators, Inc., Houston. The barge, weighing about 1,250 tons, is 300 ft. long and 60 ft. wide by 19 ft. deep. It is presently being outfitted by Brown & Root for pipe-laying operations in the Gulf of Mexico.

Todd delivered the barge in less than 8 weeks after being awarded the contract. Almost all fabrication was performed under cover in Todd's large steel fabrication shop. Movement to the launching ways took place on Todd's own rail system. Both the launching ways and the rail system are part of the new facilities recently completed at the Todd yard in Houston.

Maher Retires from OCT, Wolff Elected President

The retirement of John F. Maher from active management of Oil Center Tool Co., Houston, has been jointly announced by Maher and Ben C. Carter, executive vice president of Food Machinery & Chemicals Corp., parent company of OCT. Maher's successor as president is W. Al Wolff, formerly western manager of FMC's John Bean Division. Maher will continue to be associated with OCT in an advisory capacity.

Jim Witovec and Fritz Richard were reelected vice presidents of the Houston firm, and A. L. McMillan and Edith M. Barnes were reelected treasurer and secretary, respectively.

Oil Center Tool became a subsidiary of Food Machinery & Chemical Corp., national producer of diversified equipment and chemicals, in January 1957.

Harbison-Fischer Opens Wichita Falls Warehouse

Harbison-Fischer Manufacturing Co., Fort Worth, has opened a new warehouse in Wichita Falls, Tex. Clyde Snody is in charge of the new facility. The new warehouse will carry complete stocks of Harbison-Fischer subsurface pumps and accessory items for pumping wells.

CB&I Names Fraser, Moore, Garrett to Sales Posts

E. S. Fraser, formerly manager of Chicago Bridge & Iron Co.'s Salt Lake City plant, has been named assistant general sales manager with headquarters in Chicago. Buell Moore, who has been in the company's engineering department at the Birmingham plant since 1949, has been assigned to the New York sales office.

Elwood Garrett, recently in the Houston erection district, has been assigned to the New Orleans sales office.

Fraser, who joined CB&I in 1939, has worked in the Chicago plant, Chicago engineering and research department and was superintendent of the Salt Lake City plant and later manager of the plant before being transferred to Chicago.

Moore was named design engineer at the Birmingham plant in 1954. Garrett has worked in the Birmingham shop and Birmingham district prior to being in the Houston erection district.

Whitney Chain Names Atkins and Green

Robert G. Atkins has been appointed manager of a newly created marketing department for Whitney Chain Co. and Hanson-Whitney Division, Hartford, Conn. Curtis G. Green, Jr. has been named southwestern regional manager of Whitney Chain, with headquarters in the company's Dallas, Tex., field office and warehouse.

The new Whitney Chain department will be a centralized market fact-finding and recommending agency for both company divisions. Whitney Chain Co. produces precision roller and conveyor chains and their newly announced product, Whitney - Tormag magnetic drives. The Hanson-Whitney Division manufactures taps, gages, hobs and thread-milling machines.

Atkins joined Whitney Chain in 1941 and has been advertising and export sales manager for the past 12 years. Previously, Green had been district manager of Whitney Chain's Detroit office.

Western Appoints in Midland, Oklahoma City

Western Co., well servicing concern headquartered in Midland, Tex., has consolidated its operations and sales departments, according to H. E. Chiles, Jr., president. Sales and service now will be controlled by the new operation sales department under management of Walter Beadle, Midland, vice president of the company.

The consolidation resulted in the forming of the Oklahoma and Midland divisions, with headquarters in Oklahoma City and Midland. C. E. Woolridge has been transferred from Midland to Oklahoma City as division manager of sales and operations. Division sales manager is W. W. Wilson. Harold Parsons was moved from Midland to Oklahoma City as division operations manager.

Charles Simmons, former regional manager of operations in Midland, is the new Midland division sales manager, and Don Wolters is the new Midland division operations manager.

Youngstown's New Seamless Tube Mill Soon to Operate

Operations will begin about October 1 at the Youngstown Sheet & Tube Co.'s new seamless tube mill. The mill, located at the company's Indiana Harbor Works, East Chicago, Ind., will be the first seamless operation installed there. At present the company makes all its seamless pipe at Youngstown.

An outstanding feature of the new mill is a giant rotary furnace which will be used to heat billets before they are fed into the piercing mill. As many as 200 billets may be in the hearth at one time. The furnace is designed to handle a maximum production of 210 billets per hour, heated to a temperature of 2,200°.

Seamless tubing is used primarily by Youngstown's customers for oil well casing. Tubes 4½ to 9⅝ in. in outside diameter will be made.

Harold Hoekelman is Chicago district manager for the company.

M. J. Crose Increases Export Contracts

Export shipments are almost a daily occurrence for M. J. Crose Manufacturing Co., Inc., Tulsa. The firm manufactures a complete line of pipeline construction equipment and markets its full line on a worldwide basis.

D. T. O'Connor is the Crose company's export sales representative, with headquarters in New York City. Burton J. Matteson, Jr., formerly with Petroleum Machine Corp. of New York, has recently joined O'Connor's staff. The two recently conferred in Tulsa with Crose officials and studied the latest model Crose products.

John Manley, Crose export sales manager, states that Matteson will be traveling extensively in South America, Central America and the West Indies for regular on-the-ground coverage of those markets.

Tobin Joins Sales Staff Of Larkin of Butler

Tom Tobin has joined the sales force of Larkin of Butler. Tobin was formerly with Jones & Laughlin Supply Division at Clarion, Pa. Tobin, after a short training period, will represent Larkin & Co., Inc., Butler, Pa., in eastern areas.

Petroleum Supply Co. Appoints T. M. Fontaine

T. M. Fontaine has been appointed as sales representative for Petroleum Supply Co. Hole-Hog pump liners in southern Louisiana. This appointment is another step in an expansion program which was recently highlighted by the completion of a new manufacturing plant on Katy Highway.

During the past 4 years Fontaine has been a partner in the Petro-Plastic Engineering Co. engaged in pipeline construction in Odessa, Tex. He will be located at New Orleans and will cover a territory including Baton Rouge, Houma, Grande Isle and Venice.

Brooks Heads BJ's New Industrial Rubber Dept.

W. C. Brooks has been named to head Byron Jackson Tools, Inc.'s new industrial rubber sales department. The new department will be concerned with three areas of sales expansion for the company's PB rubber section: (1) finding new markets and uses for current BJ rubber equipment, (2) developing new BJ proprietary products in rubber, and (3) offering the complete services of a modern rubber plant to industry for solving special molded and bonded-to-metal rubber jobs. Byron Jackson's PB section has an extensive engineering department and laboratory, as well as facilities for all phases of manufacturing.

Brooks has been with Byron Jackson 12 years. He served with Standard Oil Co. as office boy, roustabout, and driller before being transferred to the purchase and stores department in Los Angeles where he rose to manager of Standard's southern division purchasing.

GE Furnishes Equipment For Floating Power Station

Highest capacity industrial floating power station known to exist has been completed at Avondale, La., for Creole Petroleum Corp. for service on Lake Maracaibo, Venezuela.

The gas turbine-generator unit and all associated electrical power distribution equipment on the barge was manufactured by seven General Electric Co. departments.

According to John P. Keller, general manager of the company's gas turbine department, Schenectady, N. Y., the barge-mounted powermaker is totally self-sufficient and designed for automatic and remote - control operations.

Heart of the floating power system is a 16,000-kw. gas turbine of General Electric's simple-cycle, single-shaft design. It will burn natural gas, with provision for switching over to distillate oil when necessary.

Avondale Marine Ways, Inc., constructed the barge hull and mounted the equipment on board. The entire electrical power generating and distributing apparatus order was placed through International General Electric, the company's overseas marketing organization.

F. I. stress pattern under polarized light in photo elasticity studies reveal stresses overlapping in desired plane as hydraulic pressure is applied within properly-spaced holes.

Stress IS THE SECRET

IN CREATING AND CONTROLLING FRACTURES

The revolutionary Fracture Initiation Process—a Western exclusive—provides a complete control mechanism for well treatments—pinpointing placement of the fracture, then controlling its extension away from the well bore. The result is a horizontal fracture, establishing the most desirable oil production pattern in any formation.

Secret of the process is the creation of a stress pattern on the horizontal plane that may be extended as a fracture when hydraulic pressure is applied. The concept of parallel forces is the only method that will CONTROL the fracture away from the well bore. Conventional perforating and radial patterns fail to establish a controllable pattern.

With Fracture Initiation Process you get controlled fracturing, minimizing the danger of fracturing into barren zones, water tables or gas caps. For the first time, you can pinpoint the fracturing process.

Get all the advantages of Western Engineered fracturing with complete fracture control—Fracture Initiation Process. Call your Western Engineer. For logging, jet perforating, fracturing and acidizing—**GO WESTERN!**

WESTERN ENGINEERING MAKES THE DIFFERENCE

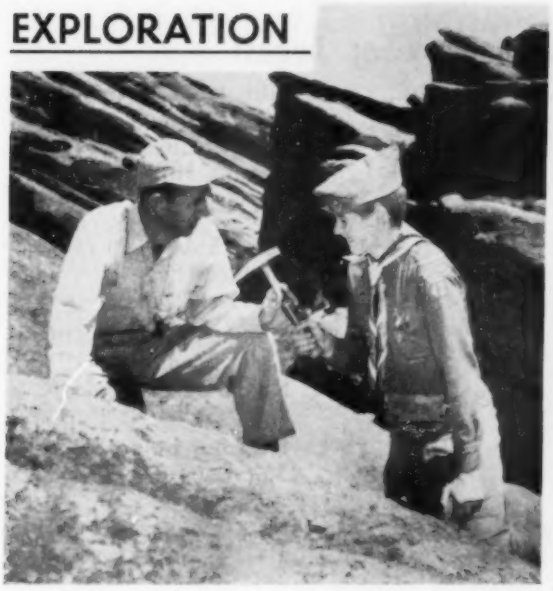
Additional Information on Request

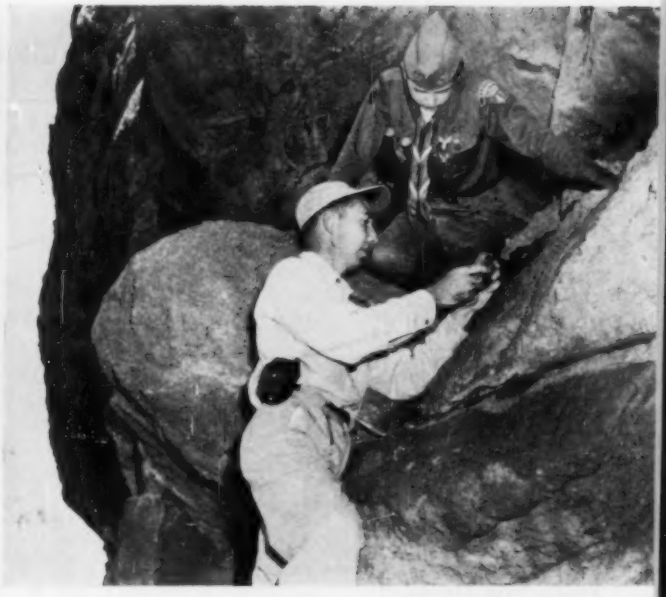
WESTERN Engineered WELL SERVICES

THE WESTERN COMPANY

general offices: *Midland, Texas*

Texas: *Odessa, Seagraves, Snyder, Lubbock, Borger, Rankin, Andrews* Oklahoma: *Lindsay, Healdton, Okla. City* New Mexico: *Hobbs* Kansas: *Ulysses, Liberal*





Geology on the rocks today . . . means an ample supply of oil finders for tomorrow.

When Good Scouts Get Together

By Frank J. Gardner
Exploration Editor

TOMORROW, October 1, the curtain rises on "the greatest show on earth." For October has been designated "Geology Month" by the Boy Scouts of America. And no doubt about it, during the next 31 days, Mother Earth will occupy the downstage-center spot as 3½ million scouts and 1 million adult leaders poke inquisitive fingers and prying hammers into her weatherbeaten skin.

The B.S.A. organization is a natural as a standby supply of geologists for tomorrow. But only in the last few years, when a shortage of oil finders seemed imminent, did the geological profession do anything about tapping this tailor-made manpower pool. With the advent of the merit badge in geology in 1953, however, and the ever-increasing emphasis on the recruitment theme, the major geological societies have made real progress in building scout interest in the earth.

Geology Month is the climax of more than a year's preparation. The American Geological Institute and the American Association of Petroleum Geologists, ably supported by the American Petroleum Institute, have prepared 75,000 Boy Scout Geology Kits. These have been sent to each of the 68,000 scout-troop units in the country, all state geological surveys, all college geology departments, and to all the local geological and geophysical societies. Along with the kits went 2 million copies of a leaflet, "Careers in Petroleum Geology," another called "Do a 'Good Turn,'" and an illustrated booklet on elementary geology.

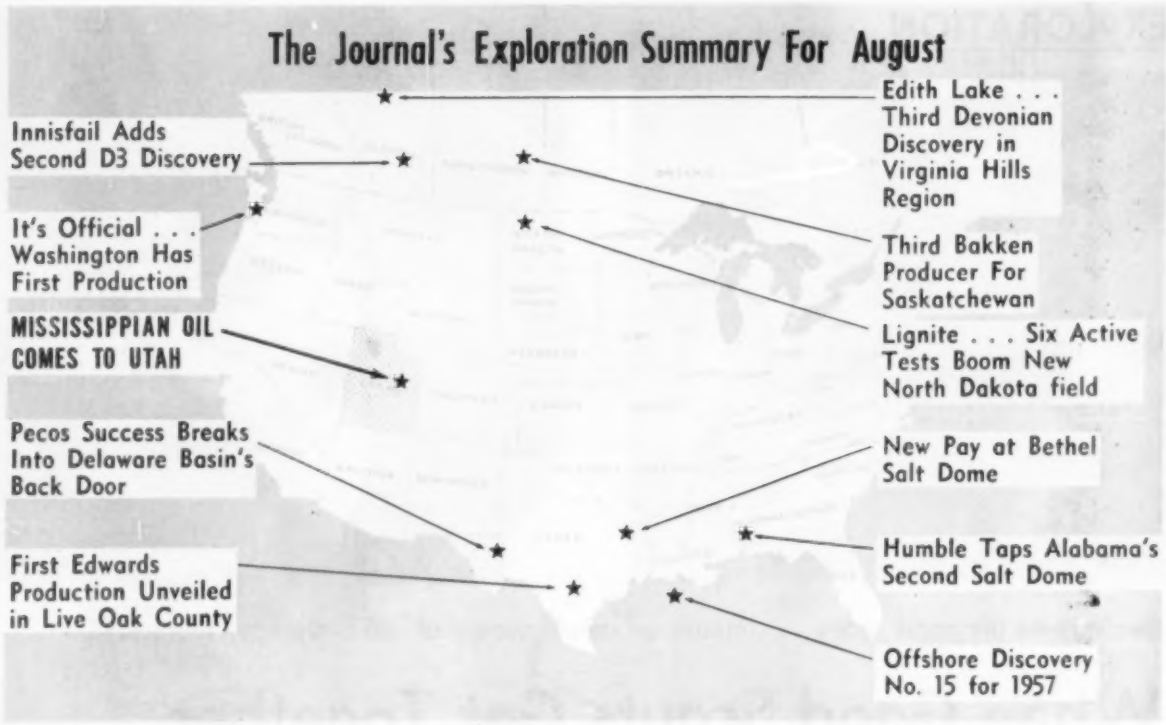
Event Is Well Timed

With the groundwork thus laid by the national groups, local societies and individual geologists now take over. In areas where geologists are scarce, leaders will be selected from working oil men in any branch of the industry. This ties in neatly with the nationwide stir connected with Oil Progress Week from October 13 to 19. The 40,000 volunteer workers of the A.P.I.'s Oil Information Committee will meet with troops and make talks, show films, and set up geological displays ranging from gems to bottles of oil.

But the real down-to-earth contact between scout and rockhound, as pictured on this page, will be the most valuable result of Geology Month. From coast to coast, scouts will don hard hats and follow geologists into mines, laboratories, oil fields, caves, and museums. They'll dig for fossils, hunt for minerals, chip rock specimens, follow outcrops, compete in displays and exhibits, look at films, build maps, and haunt derrick floors. And in the process, many of these 3½ million jean-agers are bound to decide on an oil-finding career.

At the moment, there's no serious shortage of earth scientists in the country. As a matter of fact, some members of the profession view such mass wooing of the beardless with misgiving: too many recruits will lead to an overcrowed field, they say. But with the dynamic decades that lie ahead, this seems unlikely. The dry bones of statistics point to an ever-growing demand, not only for oil finders, but for mineralogists, sedimentologists, nuclear geologists, geological engineers, and a host of other specialist groups. Therefore, by dipping into this khaki-clad reservoir of future manpower, the A.G.I., A.A.P.G., and A.P.I. are simply putting to practical use that famous Boy Scout creed, "Be Prepared."

Note: These photographs were provided by the Public Relations Department, Denver Area Council, Boy Scouts of America. The subjects are N. S. Cook, Jr., Denver consultant, and Eagle Scout Bryan Lewis, Troop 43, Denver.


The Journal's Exploration Summary For August
Edith Lake . . . Third Devonian Discovery in Virginia Hills Region
Innisfail Adds Second D3 Discovery
Third Bakken Producer For Saskatchewan
It's Official . . . Washington Has First Production
Lignite . . . Six Active Tests Boom New North Dakota field
MISSISSIPPIAN OIL COMES TO UTAH
Pecos Success Breaks Into Delaware Basin's Back Door
New Pay at Bethel Salt Dome
Humble Taps Alabama's Second Salt Dome
First Edwards Production Unveiled in Live Oak County
Offshore Discovery No. 15 for 1957

Western Canada and northern Paradox provide August news as . . .

Utah Gets First Mississippian Oil

By John C. McCaslin
District Editor

THE PARADOX BASIN got back into the exploratory agenda again in August, but for a change, the news came from the north side instead of down Aneth way. Pure Oil Co. unveiled the first Mississippian oil production for the basin, for the State of Utah, and indeed, for an area 300 miles removed from similar oil fields.

Western Canada, now in the real heat of the year's exploratory work, took the rest of the month's big news items, while Texas, Louisiana, Alabama, and North Dakota contributed important wildcat happenings. Although the story of Washington State's first oil production belongs to July, that area's first discovery became official in August.

Paradox and Mississippian . . . The mapwatchers shifted their dots to the north side of the Paradox basin when Pure Oil Co. announced success at its 1 Big Flat Unit wildcat in Grand County, eastern Utah.

This significant wildcat flowed 319 bbl. of oil in 24 hours from the Mississippian at 7,694-7,728 ft. to reveal the tremendous potential of the Mississippian section on the basin's north flanks. Pure's well is on the mobile side of the basin against the Uncompahgre uplift. Closest current Mississippian production is nearly 300 miles northeast in Wyoming. There was some Mississippian production in the Big Flat Unit, but the well proved noncommercial. Pure's discovery, 90 miles north of the flush Aneth-Pennsylvanian trend of the basin, could well be one of the exploratory highlights of 1957 for the Rocky Mountain province. Subsequent drilling in the area will tell the story.

Edith Lake . . . Home Oil Co. et al tapped the third Slave Point Devonian discovery in the general Virginia Hills-Swan Hills region, bringing to four the pools opened this year in this formation.

Home's new discovery is 6 miles southwest of Swan Hills and about 12 miles northeast of Virginia Hills. The Slave Point is a new-pay horizon for western Canada and the current activity in this region from Kaybob east to Swan Hills is the hottest thing in the country since Red Earth Creek. Flush production was established at both the Swan Hills and Virginia Hills wells—likewise at Kaybob. More development drilling is necessary around all of these areas to determine the size of the new Devonian reservoir or reservoirs.

Innisfail . . . This new Devonian D3 reservoir 60 miles north of Calgary added its second discovery in August at White Rose-C. & E. 11-3 Innisfail. The initial discovery, drilled by the same operators, had 148 ft. of net effective Devonian reef pay. Allowable is 600 bbl. per day. Innisfail promises to be one of the best reef finds in years.

The Bakken . . . This Basal Mississippian sand now produces in three areas of the province of Saskatchewan. The Riddle - Tidewater 16 - 32 Rocanville wildcat is pumping about 35 bbl. of oil daily from the Bakken, giving the

Total August Completions, Exploration and Development

	Total completions							Wildcat wells								Act.
	Total	Crude	Cond.	Gas	Dry	Service	Footage	Total	Crude	Cond.	Gas	Dry	Footage	C.T.	D.D.	op.
Alabama	6	2	0	0	4	0	30,619	4	0	0	0	4	7,708	2	0	10
Arizona	1	0	0	0	1	0	2,000	1	0	0	0	1	2,000	0	0	1
Arkansas	119	73	0	0	45	1	359,838	23	3	0	0	20	92,554	0	0	55
California	217	144	0	5	63	5	986,929	53	8	0	0	45	256,785	0	1	216
Colorado	76	10	0	6	60	0	396,812	54	3	0	2	49	273,379	0	0	88
Illinois	331	124	0	0	207	0	762,337	84	3	0	0	81	176,448	120	4	375
Indiana	85	25	0	0	60	0	147,006	16	0	0	0	16	22,674	74	0	91
Kansas	468	210	0	27	225	6	1,712,239	100	15	0	1	84	407,878	29	3	540
Kentucky	180	67	0	7	106	0	247,142	36	0	0	1	35	54,379	160	0	225
West	173	67	0	2	104	0	227,136	34	0	0	0	34	48,883	160	0	140
East	7	0	0	5	2	0	20,006	2	0	0	1	1	5,496	0	0	85
Louisiana	347	165	5	41	136	0	2,489,529	57	5	1	3	48	551,312	0	0	415
North	147	81	1	11	54	0	519,710	18	1	0	0	17	97,444	0	0	68
South	149	58	4	24	63	0	1,491,227	33	3	1	2	27	378,598	0	0	256
Offshore	51	26	0	6	19	0	478,592	6	1	0	1	4	75,270	0	0	91
Michigan	39	12	0	11	16	0	113,626	9	0	0	0	9	24,363	21	0	72
Mississippi	37	6	3	2	26	0	323,305	24	2	0	0	22	210,816	0	1	57
Missouri	2	0	0	0	2	0	2,381	2	0	0	0	2	2,381	2	0	0
Montana	50	22	0	4	24	0	190,603	19	0	0	0	19	65,747	5	0	52
Nebraska	102	39	0	0	63	0	601,290	50	4	0	0	46	285,758	0	0	40
West	101	39	0	0	62	0	596,894	49	4	0	0	45	281,362	0	0	40
East	1	0	0	0	1	0	4,396	1	0	0	0	1	4,396	0	0	0
Nevada	3	0	0	0	3	0	11,717	3	0	0	0	3	11,717	0	0	2
New Mexico	215	108	0	61	44	2	989,397	34	6	0	1	27	137,591	0	1	267
Northwest	109	30	0	58	20	1	457,105	18	3	0	0	15	70,159	0	0	135
Southeast	106	78	0	3	24	1	532,292	16	3	0	1	12	67,432	0	1	132
New York	35	17	0	0	0	18	35,000	0	0	0	0	0	0	35	0	28
North Dakota	19	10	0	0	9	0	142,291	11	2	0	0	9	70,720	0	0	53
Ohio	146	70	0	29	36	11	332,289	3	1	0	0	2	10,605	140	0	163
Oklahoma	658	356	7	23	245	27	2,239,916	78	6	0	3	69	334,800	69	32	971
Pennsylvania	42	13	0	12	7	10	138,141	3	0	0	0	3	13,455	39	3	97
S. Dakota	4	1	0	0	3	0	18,459	4	1	0	0	3	18,459	0	0	4
Texas	2,125	1,206	60	87	758	14	8,760,417	440	35	3	7	395	2,052,570	90	12	1,205
Dist. 1	113	47	1	5	60	0	281,529	44	4	0	1	39	113,394	2	0	57
Dist. 2	87	25	10	11	41	0	529,955	28	0	1	1	26	191,902	0	0	28
Dist. 3	139	55	14	2	68	0	931,712	35	2	0	0	33	280,796	0	0	114
Dist. 4	134	51	13	8	60	2	684,834	36	3	2	2	29	200,957	0	1	79
East	143	87	11	1	44	0	646,523	28	1	0	0	27	137,327	1	1	55
Dist. 7-B	281	140	2	1	138	0	836,593	88	11	0	0	77	293,459	36	1	85
West	614	474	3	5	128	4	2,972,147	81	9	0	1	71	484,945	44	9	581
Dist. 9	459	248	0	9	194	8	1,293,847	88	3	0	2	83	273,046	7	9	105
Dist. 10	155	79	6	45	25	0	583,277	12	2	0	0	10	76,744	0	0	101
Utah	28	11	0	0	17	0	149,058	15	1	0	0	14	74,132	0	0	93
West Virginia	70	12	0	47	11	0	185,840	3	0	0	1	2	13,961	68	0	259
Wyoming	101	45	0	5	51	0	474,245	36	3	0	1	32	156,294	14	4	134
Aug. 1957	5,506	2,748	75	367	2,222	94	21,842,426	1,162	98	4	20	1,040	5,328,486	868	61	5,513
July 1957	4,299	2,138	43	312	1,718	88	17,666,497	981	75	4	26	876	4,437,610	661	26	5,350
Cum. 1957	35,566	18,453	340	2,557	13,489	727	147,253,790	7,957	826	65	284	6,782	37,346,401	5,319	345	....
Cum. 1956	39,500	21,224	326	2,683	14,586	681	159,580,000	8,677	1,114	....	278	7,285	41,491,000	....	....	....

Note: C.T. = cable-tool comp. D.D. = O.W.D.D. Act. op. = active operations.

Western Canada

	Total wells					Cum.	Wildcat wells					Cum.
	Total	Oil	Gas	Dry	Footage	1957	Total	Oil	Gas	Dry	Footage	1957
Alberta	124	82	18	24	642,953	950	33	8	8	17	179,514	265
Saskatchewan	114	79	2	33	487,871	818	23	4	0	19	88,817	195
Manitoba	16	3	0	13	40,803	174	9	0	0	9	25,391	49
British Columbia	3	1	1	1	16,553	60	3	1	1	1	16,553	37
Northwest Territory	....	....	....	....	....	3	....	....	....	....	....	3
Total	257	165	21	71	1,188,180	2,005	68	13	9	46	310,275	549

area 12 miles east of Wapella town a new pay and a new oil pool. Other Bakken production in the province is at Roncott 200 miles southeast, and at Coleville. There is some Bakken production in North Dakota, but Basal Mississippian discoveries have been few and far between in Williston basin activity.

Lignite . . . Off-Nesson anticline exploration continues to be popular in North Dakota. The best Burke County discovery yet was recently completed by Northwest Oil Drilling Co. 10 miles southeast of Columbus field. It made 225 bbl. per day from the Midale-Mississippian. There are now six active tests in and around Lignite field, making it the busiest single area in the state.

New Texas interest . . . Exploratory news is never lacking in Texas. August was no exception with signs of a real oil province shaping up in the Sheffield Channel, further extension of the Edwards trend, and a new pay discovery on East Texas' Bethel salt dome.

. . . Delaware's back door. A big effort to find pre-Permian oil in the deep sediments of Pecos County in West Texas is paying off with a good Ellenburger discovery 35 miles southeast of Fort Stockton.

Standard Oil Co. of Texas 1 Hokit flowed 720 bbl. of oil per day on a deep drill-stem test, opening a new pool 10 miles northeast of nearest production at Puckett field, the state's deepest producing area at 15,000 ft. plus.

The new Pecos surprise is in the Sheffield Channel, a buried feature said to connect the Delaware basin on

Breakdown of Wildcats Drilled in August 1957, by Depth

	Oil									Gas									Dry								
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
Alabama																			1	2	1						
Arizona																				1							
Arkansas			1	1	1														1	3	10	5		1			
California		4		1		1	1	1											2	11	4	11	13		4		
Colorado				1	1		1							2					1		2	29	15	2			
Illinois		1	2																17	36	28						
Indiana																			7	8	1						
Kansas			6	7	2								1						1	3	36	26	18				
Kentucky												1							16	15	4						
West																			16	14	4						
East												1								1							
Louisiana			1				3	2								1	2		1	1	3	2	9	6	13	11	2
North			1																	1	3	2	9	1	1		
South							3	1								1	1		1					4	12	8	2
Offshore								1									1							1		3	
Michigan																				2	7						
Mississippi					1	1															1	1	11		4	4	1
Missouri																			1	1							
Montana																			1	4	8	3	3				
Nebraska					4															1	3	7	35				
West					4															1	3	6	35				
East																						1					
Nevada																					2	1					
New Mexico			2	1	1		1	1			1								3	9	6	5	2	1	1		
Northwest			1	1	1														2	3	5	3		1	1		
Southeast			1				1	1			1								1	6	1	2	2				
North Dakota					1	1															4	1	1	2	1		
Ohio			1																	1		1					
Oklahoma			1	2	2	1					1			2					8	11	12	14	16	6	2		
Pennsylvania																						3					
South Dakota						1														1	1		1				
Texas		4	8	6	8	5	6	1			2		3	2					33	94	56	56	82	55	16	1	2
Dist. 1			3	1							1								16	9	7	1	3	3			
Dist. 2							1						1								1	3	11	10	1		
Dist. 3						1	1														3	1	7	17	4		1
Dist. 4			1	1	3						1		1						4	1	1	2	9	11		1	
East						1													2	3	2	4	15		1		
Dist. 7-B		3	2	3	3														4	30	14	17	11	1			
West			1		1	2	4	1					1						2	11	12	13	14	9	9		1
Dist. 9		1		1	1									2					5	39	14	13	12				
Dist. 10			1			1															1	2	2		4	1	
Utah					1														1	2	1	2	7	1			
West Virginia													1								1		1				
Wyoming		1			2										1				7	5	5	2	7	5	1		
Total U. S.		10	22	19	24	10	12	5			4	1	5	6	1	1	2		101	211	196	169	221	79	42	16	5
Western Canada		2	2	5	2	2						3		1	3		2			10	14	11	9	2			
Alberta		1	1	3	1	2						3			3		2			4	4	3	4	2			
Saskatchewan		1	1	1	1															2	6	8	3				
Manitoba																				4	4		1				
British Columbia				1										1									1				

NOTE: A = 0-1,250 ft.; B = 1,250-2,500 ft.; C = 2,500-3,750 ft.; D = 3,750-5,000 ft.; E = 5,000-7,500 ft.; F = 7,500-10,000 ft.; G = 10,000-12,500 ft.; H = 12,500-15,000 ft.; I = 15,000 ft.

Breakdown of Field Wells Drilled in August 1957, by Depth

	Oil									Gas									Dry								
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
Alabama							2													7	16	2	1				
Arkansas		47	11	10	1	1														4	8	3	5	2	1		
California	20	35	22	13	17	15	6	8				1		4							1	3	5				
Colorado				2	2	3							1	3					2								
Illinois	6	51	61	3															17	44	63	2					
Indiana	2	22	1																11	28	5						
Kansas		56	109	30									15	8	3					4	100	29	14				
Kentucky	38	27	2							3				3					31	33	7						
West	38	27	2							2									31	32	7						
East										1				3						1							
Louisiana	3	58	14	8	16	34	23	6	2	1	7			2	6	12	10		3	9	14	8	9	20	18	6	1
North	2	52	14	4	4	3	2			1	7			2	1				1	8	12	6	5	4	1		
South	1	6		4	6	16	17	6	2						4	9	9		2	1	2	1	1	11	12	5	1
Offshore					6	15	4								1	3	1					1	3	5	5	1	
Michigan		2	5	5							1	10								2	5						
Mississippi					2	1	4						1	1								1	1		1	1	
Montana		8	2	1	5	6				4									1	2	1	1					
Nebraska				1	34																1		15				
New Mexico		10	23	35	19	4	9	2			12	17	7	23	1				1	4	3	8			2	1	
Northwest		3	3	4	17						12	17	5	23	1					3	1	2					
Southeast		7	20	31	2	4	9	2					2						1	1	2	6			2	1	
New York	17																		18								
North Dakota						8																					
Ohio	22	16	27	4						8	10	7	4						15	13	14	3					
Oklahoma	60	87	82	54	54	18	1	1			3	5	2	9	1				64	63	40	20	13	2	1		
Pennsylvania	5	8								1	1	3		7						7	6		1				
Texas	91	264	323	188	238	89	24	11			26	25	11	13	3	1	1		57	38	147	45	54	32	2	2	
Dist. 1	10	14	15	4		1					2			1		1			8	7	3	2	1				
Dist. 2	3			9	11	10	1					3	4	3						1	2	4	5	2		1	
Dist. 3	4	3	4	14	18	19	5					1	1						3	1	6	2	4	19			
Dist. 4	1	10	17	2	19	9		1				2	2	2						5	9	4	12	3			
East	16	12	8	16	34	11									1				6	2	2		7				
Dist. 7-B	27	36	27	28	13								1						15	22	7	9	8				
West	4	60	166	71	108	32	17	10			1	1	1				1		3	10	24	13	3	6	1	1	
Dist. 9	26	125	22	40	31	1							1	6					22	59	15	11	12				
Dist. 10		4	64	4	4	6	1				23	18	1	1	2					4	6		2	2	1		
Utah					10																		3				
West Virginia	2	10								1	22	11	12														
Wyoming	2	2	14	4	10	10							1	1	2					5	3	1					
Total U. S.	268	703	696	358	408	189	69	28	2	18	82	94	50	66	13	13	11		225	265	437	130	124	58	26	10	1
Western Canada		10	11	88	34	9					3	5	3	1						5	3	13	3	1			
Alberta		6	4	21	34	9					2	4	3	1						1		2	3	1			
Saskatchewan		1	7	67							1	1								1	2	11					
Manitoba		3																		3	1						

NOTE: A = 0-1,250 ft.; B = 1,250-2,500 ft.; C = 2,500-3,750 ft.; D = 3,750-5,000 ft.; E = 5,000-7,500 ft.; F = 7,500-10,000 ft.; G = 10,000-12,500 ft.; H = 12,500-15,000 ft.; I = 15,000 ft.

Footage Breakdown for August 1957

	Fields			Wildcats		
	Oil	Gas	Dry	Oil	Gas	Dry
Alabama	22,911					7,708
Arkansas	190,842		76,442	11,899		80,655
California	630,993	25,700	73,451	45,963		210,822
Colorado	49,890	24,515	49,028	20,104	12,493	240,782
Illinois	284,954		300,935	7,793		168,655
Indiana	46,748		77,584			22,674
Kansas	646,978	87,178	570,205	59,244	4,583	344,051
Kentucky	79,434	14,292	99,037		3,571	50,808
West	79,434	1,362	97,457			48,883
East		12,390	1,580		3,571	1,925
Louisiana	982,663	355,232	600,322	63,220	38,966	449,126
North	253,164	39,060	130,042	2,975		94,469
South	514,492	260,482	337,655	46,220	24,926	307,452
Offshore	215,007	55,690	132,625	14,025	14,040	47,205
Michigan	42,508	28,336	18,419			24,363
Mississippi	66,864	12,342	33,283	12,553		198,263
Missouri						2,381
Montana	110,496	3,096	11,264			65,747
Nebraska	214,368		101,164	23,624		262,134
West	214,368		101,164	23,624		257,738
East						4,396
New Mexico	509,932	254,048	87,826	42,850	1,628	93,113
Northwest	123,171	246,163	17,612	13,559		56,600
Southeast	386,761	7,885	70,214	29,291	1,628	36,513
Nevada						11,717
New York	17,000		18,000			
North Dakota	71,571			16,062		54,658
Ohio	187,955	56,991	76,738	3,409		7,196
Oklahoma	1,208,750	91,904	604,462	32,871	17,015	284,914
Pennsylvania	22,780	69,732	32,174			13,455
South Dakota				8,824		9,635
Texas	5,072,024	303,006	1,332,817	232,669	28,635	1,791,266
Dist. 1	102,599	20,822	44,714	13,919	1,515	97,960
Dist. 2	208,435	43,988	85,630	12,000	4,453	175,449
Dist. 3	426,771	7,514	216,631	19,023		261,773
Dist. 4	293,005	26,324	164,548	26,002	6,303	168,652
East	443,164	9,235	56,797	7,568		129,759
Dist. 7-B	381,368	4,080	157,686	42,869		250,590
West	2,219,694	23,596	243,912	86,426	4,710	393,809
Dist. 9	684,218	40,636	295,947	12,825	11,654	248,567
Dist. 10	312,770	126,811	66,952	12,037		64,707
Utah	58,269		16,657	5,959		68,173
West Virginia	20,501	128,538	22,840		4,835	9,126
Wyoming	216,021	27,041	74,889	15,742	8,416	132,136
Arizona						2,000
Total U. S.	10,754,452	1,481,951	4,277,537	602,786	120,142	4,605,558
Western Canada	729,130	45,660	103,115	62,029	67,786	180,460
Alberta	387,239	39,978	36,222	42,312	62,156	75,046
Saskatchewan	335,622	5,682	57,750	15,572		73,245
Manitoba	6,269		9,143			25,391
British Columbia				4,145	5,630	6,778

the west to the Val Verde basin on the east. There has been little drilling in this channel due to little subsurface control and poor seismic pictures. Sediments are deep and inviting—six current wildcats in the channel area hope to open a door into the backside of the Delaware basin.

. . . More Edwards. A rank Live Oak County wildcat opened first Edwards lime production in this southwestern Texas area. Standard Oil Co. of Texas 1 Isaacks flowed 1,350 M.c.f. of gas per day, moving the Edwards play coastward following a southwesterly-northeasterly trend through LaSalle, McMullen, and Atascosa counties into Karnes and Live Oak on the northeastern end. Nearest Edwards production is more than 15 miles at Green Franklin.

. . . New pay. The Texas Co. added gas-condensate production to regular oil output at Bethel salt dome in Anderson County, East Texas. The new deep pay is of Lower Cretaceous age, the Rodessa. First production was opened on this dome last year in the Woodbine.

Louisiana offshore . . . Union Producing Co. opened the fifteenth new field to be found this year in the Gulf of Mexico off South Louisiana's St. Mary Parish, 20 miles from shore. The Block 53, Eugene Island area wildcat flowed 440 bbl. of oil per day.

Salt dome found . . . A deep wildcat 55 miles northeast of Mobile uncovered Alabama's second known salt dome. The well is a Humble dry wildcat, 20 miles northeast of the state's only other known dome at McIntosh. The new one is in Clarke County. It is a deeply seated, nonpiercement salt mass, while McIntosh is a shallow, piercement dome.

No. 32 . . . Washington joined the ranks of oil-producing states in August, becoming No. 32. The discovery well is Sunshine Mining Co. et al 1 Medina near Ocean City in Grays Harbor County. The well flowed 223 bbl. per day on production tests from the Nye-Miocene sand. The new pool sits below mean high tide on the Pacific Ocean coastline of Washington. **End.**

Fall Field Trip Announced By South Texas Society

Friday, October 4, the South Texas Geological Society of San Antonio will hold a fall field trip. The group will visit Eocene outcrops in Milam and Burleson counties. The section to be studied is from the upper Wilcox to the Crockett formation of the Claiborne group. Dr. Fred Smith, of Texas A. & M. College, will be chairman and leader of this trip which is a repetition of the one conducted for members of the Gulf Coast Association of Geological Societies in 1956.

Private automobiles will be used and individual arrangements must be made. Assembly point will be Milano in Milam County at 9 a.m. The Milano fault will be studied then cars will continue on to Brazos River on the road to Hearne. The group will travel to the southeast down the Brazos and stop at the Yegua formation at Bryan.

BOOK

GEOLOGIC CROSS-SECTION OF THE PALEOZOIC ROCKS FROM NORTHWESTERN TO SOUTHEASTERN OHIO by George G. Shearrow. Published by Ohio State University, Columbus 10. 42 pp. 50 cents plus 2 cents tax in Ohio.

This is Report of Investigations No. 33. The cross-section was made after the study of the cuttings and residues from 12 wells located in 10 counties was completed. Correlations with Michigan and West Virginia formations are included.

EXPLORATION THIS WEEK

Appalachian	147
California	147
Canada	147
Illinois Basin	149
Louisiana	149
Michigan	150
New Mexico	150
Oklahoma	150
Rocky Mountains	152
Texas	152
Oregon	156
Washington	156
Wildcats	156

EXPLORATION HIGHLIGHTS

APPALACHIAN

OHIO

East Extension Added To Reese Pool

A location east extension of Reese pool in Tiverton Township, Coshocton County, was completed by W. E. Shrider et al on 1 (3) Rema Mullet, Section 21. Clinton at 3,233-88 ft., gaged 5 bbl. natural and 100 bbl. with 500,000 cu. ft. gas in 24 hours after fracture.

Frazeysburg Area Pool Nets Third Producer

A third producer was finished in the new pool northwest of Frazeysburg. The Natol 1 Walter McCann, Section 13, Jackson Township, Muskingum County, logged the Clinton at 3,011-71 ft. with 50 bbl. in a 24-hour test after fracture.

Oil Found in Northwest Madison Township

Some oil produtcion is now being found in the northwest corner of Madison Township, Perry County.

Natol Corp. 1 (2) J. H. Denny, Section 6, found the Clinton at 3,058-82 ft. with 45 bbl. in 24 hours after fracture.

EASTERN KENTUCKY

Testing Under Way At Breathitt Wildcat

In Breathitt County and located on South Fork of Quicksand Creek, United Fuel Gas Co. is testing their wildcat 1 L. W. Wolferberger et al. Significant markers penetrated include: Mississippian Big lime 1,335 ft., Berea sand 1,955 ft., Corniferous lime 2,374 ft., Big Six (Silurian) 2,570 ft. and Clinton (Silurian) shale 2,880 ft. Total depth of hole is 2,968 ft. Several shows of oil and gas were had during drilling. Latest test of Corniferous gas showed 61,000 cu. ft. daily after acidization and shooting.

CALIFORNIA

Three More Deep Wells Completed at Fillmore

Development of the deep Fillmore field in Ventura County continues in a northeasterly direction with two of three recent completions setting new productive limits for the field.

One was Humble Oil & Refining Co. 1 Fillmore Operating Unit in 24-4n-20w, which set a new north limit on the field. This well was brought in flowing 355 bbl. daily of 31.7°-gravity crude through a ¼-in. choke from perforations at 13,868-72, 13,881-86, 13,905-37 ft. Total depth is 14,025 ft. Humble also completed another well, 2 May Easton in SW NW 25-4n-20w, for 301 bbl. daily from perforations at 13,846-50 ft. and 13,882-13,953 ft.

A new eastern limit to the field was set by Richfield Oil Corp. with the 14,125 ft. 1 Richfield-Union-Fillmore Community in SW NE 25-4n-20w. It was flowing 749 bbl. daily of 30.8°-gravity oil through a 20/64-in. choke from 13,840-13,900 and 14,000-40 ft.

Texaco Misses in Old Tompkins Hill Field

The Texas Co. has plugged and abandoned at 5,100 ft. its test in the old Tompkins Hill gas field in Humboldt County. This unsuccessful extension try was drilled ¾-mile south of Tompkins Hill production. Back in 1939, Texaco scored with two gas producers drilled to depths of 5,067 ft. and 7,708 ft.

Reserve Gets Big Well at Oxnard

Reserve Oil and Gas Co. has completed 2 Duntley, its first extension test to its play on the west edge of the Oxnard field in Ventura County, flowing 458 bbl. daily from three perforated intervals. For the completion, Reserve ran 126 ft. of 5½-in. liner to the bottom at 6,525 ft. with perforations at 6,430-58 ft., 6,469-6,505 ft., and 6,513-25 ft. On an earlier formation test of 6,430-6,525 ft., the well flowed at a rate of 1,171 bbl. daily.

CANADA

ALBERTA

Rocky Mountain Front Exploration Successful

The Central Alberta Foothills Agreement Group, made up of the British American Oil Co., Ltd., Triad Oil Co., Royalite Oil Co. and Sun Oil Co. revealed big happenings along the Rocky Mountain front of central-west Alberta. Two wells which the team is currently drilling, 36 miles apart, indicated new gas discovery in the same zone on its large spread of Reservation rights which run in a northwest-southeast direction for a stretch of 150 miles in a solid block and which cover rights to approximately 1,300,000 acres. The most encouraging of the two, possibly, is the test in the Lovett River area, where gas flow rates of up to 5,000,000 cu. ft. daily have been recovered during initial tests in the Rundle portion of the Mississippian covering 130 ft. of zone; while the other, a previous gas discovery in a higher porous zone of the same formation, indicated success during four consecutive drill-stem tests taking in a total of 226 ft. of zone. Flow rates on the latter well, lying in the Stolberg region southeast of the other strike, were inconclusive during drill-stem test and were not revealed, however, the team must consider them commercial as production casing is currently being run in the hole to enable further evaluation tests to be carried out.

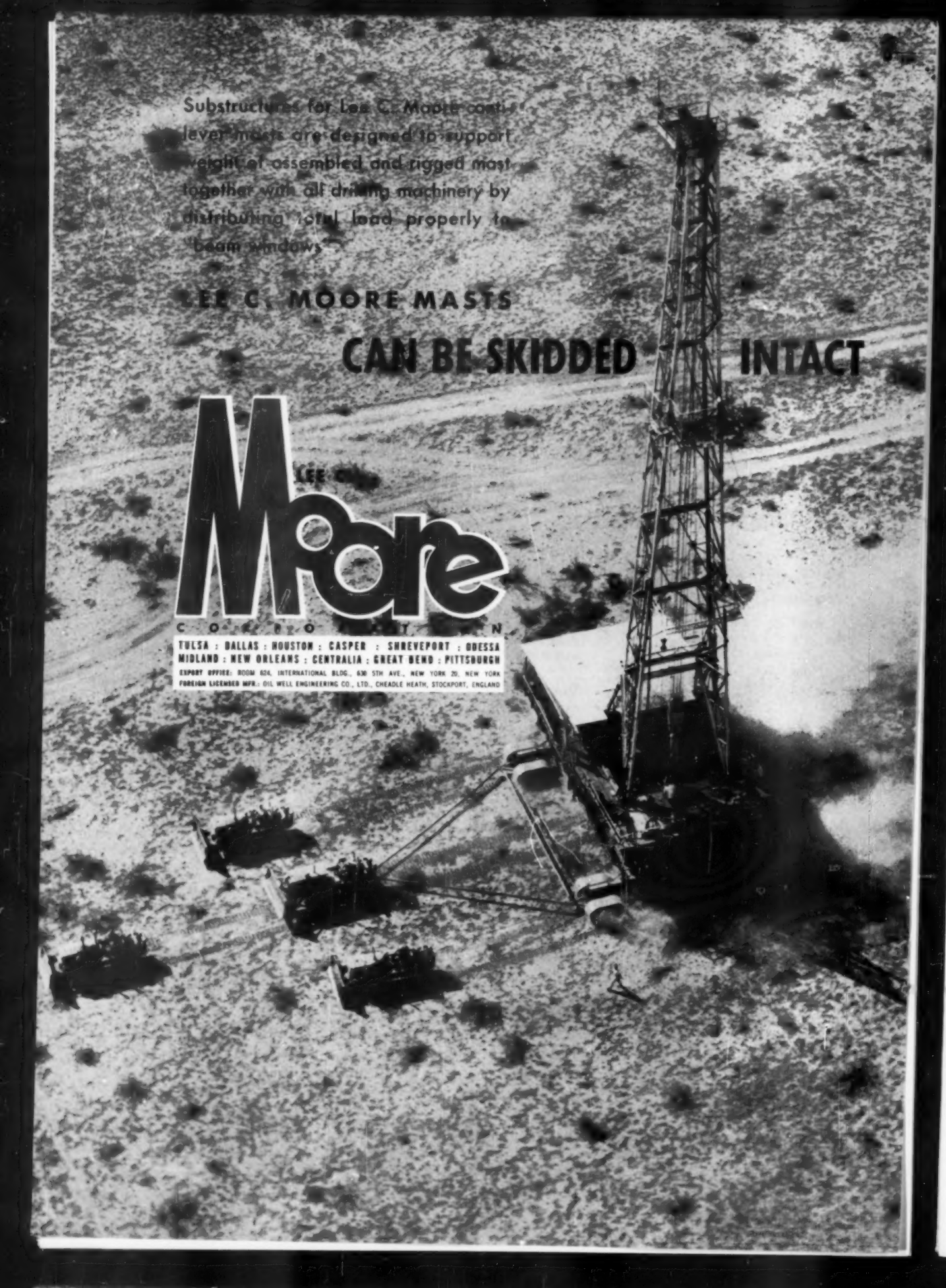
The B.A. et al 12-30 Lovett River venture, is being drilled on LSD 12, 30-46-18w5. It lies 130 miles west-southwest of Edmonton, 10 miles southeast of Foothills town and 42 miles south of Edson. The Mississippian horizon was contacted around the 11,600-ft. level and drill-stem tests have flowed gas at rates up to 5,000,000 cu. ft. daily.

Triad el al 6-10A Stolberg, on LSD 6, 10-42-15w5, it will be remembered discovered a gas-bearing structure early in June, when, after acidization a flow rate of distillate-bearing gas in excess of 8,500,000 cu. ft. daily was reported. A fault was encountered below that structure and drilling operations resumed, until recently 1,300 ft. below the base of that gas zone another section was encountered. The venture was carried to total depth below 13,300 ft. and production casing has been set.

Full Pay Zone Penetrated at Edith Lake

Home Oil Co., Ltd., operator of the Home Oil et al Regent 11-19 Edith Lake Slave Point oil discovery well in central-west Alberta, reported that the full pay sector has been penetrated and production casing will be set prior to carrying it on down to test the basement at 9,500 ft. The Middle Devonian zone from which oil flows were recorded on initial series of drill-stem tests was 315 ft. thick, with the top of the Slave Point (porous sector of the Beaverhill Lake) coming in at 8,195 ft. and the base at 8,510 ft.

R. A. Brown, Jr., president of Home, stated that the first 146 ft. is continually porous with good to excellent porosity. The section below from 8,341 to 8,510 ft. contains some nonporous reef limestone but with oil bearing


Substructures for Lee C. Moore cantilever masts are designed to support weight of assembled and rigged mast together with all drilling machinery by distributing total load properly to beam windows.
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porous intervals throughout. A drill-stem test of the lower portion of the formation from 8,479 to 8,514 ft. yielded 180 ft. of light gravity oil and 180 ft. of oil cut mud in 75 minutes. Brown further advised that a 72-ft. section above the Slave Point in the Pekisko formation at a depth of 5,000 ft. was also oil-saturated with heavy-gravity crude. No complete testing of this potential horizon has yet been made.

The Home Oil's three successes in the general region have fired the imagination of the oil industry and Brown commented "that with the coming of the winter season, working conditions in the area will greatly improve." While it is yet to early to make an announcement on the extent of increase in drilling during the coming months by Home, he did say that he expected this area to highlight the Alberta exploration effort during the coming season.

BRITISH COLUMBIA

Second Mississippian Discovery Reported

The second Mississippian oil discovery in the northeastern sector of British Columbia was reported on by Fargo Oils, Ltd. The new hole lies in the Blueberry River region, 55 miles northwest of Fort St. John, which up till now has been renowned only as a gas producing area. The newest of the two finds, White-Lloyd-Fargo 16 Blueberry, is situated in unsurveyed territory 5 miles north of the previous No. 11 strike.

During production tests on the venture, through restricted chokes the well flowed at the rate of 800 bbl. per day over a 3-day period. That is better than the initial strike as it produced a daily average rate of 569 bbl. daily. As well as assuring its backers of oil success in the Mississippian this same well has a substantial gas cap in the zone and indicated large quantities of gas in the Nikinassin and Triassic formations during earlier drilling operations.

According to an announcement by Fargo, who has a substantial interest in the program along with White-Lloyd and Associates of Texas, and the Gulf States Oil Co., the No. 11 and 16 wells represent the most important oil strike in British Columbia to date. It is the most northerly proved oil producing area in the province and promises to be of major proportions. Reserve estimates have not been made as to the extent of this formation and only further drilling operations will determine the full worth of the discoveries. Based on presently known facts, however, the reserve appears to be quite large.

ILLINOIS BASIN

ILLINOIS

St. Louis Discovery Reported in Gallatin

A St. Louis lime discovery was reported 1 mile southeast of New Haven and ½ mile from other production in Gallatin County. The new strike is George S. Engle 1 Leona Wood Wiseheart, SE SE SE 21-7s-10e. The well pumped 130 bbl. of oil the first day from 2,961-68 ft.

WESTERN KENTUCKY

New Area Developing Near Curdsville

A new producing area is shaping up in Daviess County, 2 miles southwest of Curdsville. Indiana Farm Bureau and Ralph Halbert 2 M. O. Towery Community, 11-O-26, swabbed 36 bbl. of oil per day, natural, from Palestine at 1,356-70 ft. Another well has had casing set to test the Palestine at 1,358-75 ft. It is the 3 Towery Community.

LOUISIANA

NORTH LOUISIANA

Mean Lake Discovery Well Completed

The Mean Lake area discovery in Catahoula Parish, east-central Louisiana, was completed flowing 165 bbl. of 43°-gravity oil per day from Wilcox at 4,371-73 ft. The discovery well is Durbin Bond & Co., Inc. 1 Tensas Delta Land-Monaghan Land Co. 4⅜ miles southeast of the town of Harrisburg.

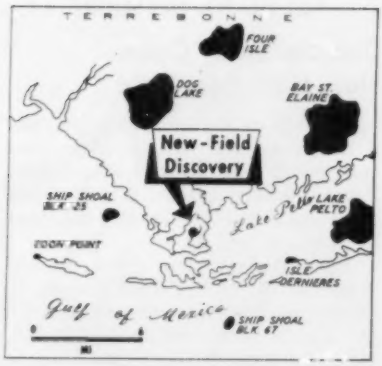
Tensas Parish Discovery Completed at Van Buren

The Van Buren Bayou discovery well, 1⅜ miles northwest of Locust Ridge field in Tensas Parish, northeastern Louisiana, was completed flowing 114 bbl. of 52°-gravity oil per day on 6/64-in. choke from perforations in the Tuscaloosa at 9,023-29 ft. It is the Jett Drilling Co., Inc. 1 Tatum in 35-11n-11e.

SOUTH LOUISIANA

Marsh Wildcat Produces In Terrebonne Discovery

Natural Gas & Oil Co. has uncovered another oil field in the coastal marsh region of Terrebonne Parish.



ARROW points to Natural Gas & Oil Co.'s new oil discovery in coastal marsh region of Terrebonne Parish.

Its discovery well, on State Lease 3141, in Round Bay, just inland from the Gulf of Mexico, flowed at the rate of 168 bbl. of 38°-gravity oil when tested through 7/64-in. choke. Flow was with gas-oil ratio of 518 cu. ft. per barrel and pressure of 1,300 psi. Its Miocene sand is perforated at 8,996-9,008 ft.

Location is about 5 miles northwest of Union Oil Co.'s deep discovery well completed last March at Isle Dernieres, in Lake Pelto. Within a radius of 6 to 10 miles are such older, important fields as Dog Lake, Bay St. Elaine, and Lake Pelto.

Second Well Produces In New Vermilion Field

Superior Oil Co.'s second well in its newly discovered field in the southeastern portion of White Lake, Vermilion Parish, is being completed as a gas-condensate well in slightly deeper zones than that in which the discovery well is productive.

Its pay is perforated at 12,757-67 ft., and flowed at the rate of 145 bbl. of 44.1°-gravity condensate with 5,323,000 cu. ft. of gas per day through ¼-in. choke.

Location is northeast of the field's discovery well, completed in an oil sand, perforated at 12,570-76 ft. The latter well flowed 296 bbl. per day through 5/32-in. choke, with gas-oil ratio of 1,175 cu. ft. per barrel. Gravity of the oil is 41.8°.

Prior to completing in the 12,570-ft. sand, the discovery well had tested gas and condensate in a deeper pay, perforated at 14,267-73 ft.

This new field, 6 miles southeast of West White Lake field and about the same distance northwest of the large Pecan Island gas-condensate field, is regarded as one of Louisiana's more important discoveries this year.

LOUISIANA OFFSHORE

Gas Discovery Opens New Main Pass Field

Kerr-McGee Oil Industries, Inc., has a new discovery well in Main Pass area, off the east coast of Plaquemines Parish's delta peninsula. It is in Block 53, about 2 miles south of production in Blocks 46 and 47.

Tested through ¼-in. choke, the well flowed at the rate of 4,851,000 cu. ft. of gas per day under pressure of 3,300 psi. Pay is perforated at 9,683-95 ft. Hole was drilled to 11,000 ft.

Location is about 3 miles northeast of the large Grand Bay field.

MICHIGAN

Scipio Pool Is Center of Action

A field location in the new Scipio pool, Hillsdale County, flowed 148 bbl. per hour from Trenton lime, a new Niagaran oil horizon was opened in St. Clair County, and wildcats showed for potential new pool openers.

Aurora Gasoline and McClure 1 Stevens SE SW NE 10-5s-3w, Hillsdale County, flowed 296 bbl. on 2-hour test through ¾-in. choke from Trenton lime pay after drilling 5-in. casing cement plug. Well was pinched to 150 bbl. per day. Operators estimated potential flow up to 5,000 bbl. per day.

Stevens well, fourth in the field, lost circulation while drilling Trenton, top 3,450 ft., at 3,769½ ft. September 6 and blowout followed. Well flowed wild 25 hours before killing with salt slurry. It was cased and cemented with 550 sacks, and drilled out to 3,772 ft. On first run of swab well flowed 90 bbl. oil, water and mud, then flowed steady at 148 bbl. per hour.

Niagara Is New Oil Pay in Peters Field

Glen A. Mills 1 Watos, SE SW NW 22-4n-15e, St. Clair County, location in Peters (Salina) gas field, logged Brown Niagara at 2,579 ft. and bottomed at 2,618 ft. with 700 ft. oil natural. Treated with 500 gal. acid well flowed 135 bbl. net and was averaging 75 bbl. 39°-gravity oil after fourth day on test. Well probably will complete as new pay discovery.

Midland County Wildcat Flows Oil

Frank E. Roush and J. C. Vorhees 1 Ostrander SW NW SE 26-10n-3e, Saginaw County testing Squaw Bay section of upper Traverse at 2,808 ft. Well flowed 145 bbl. oil first 14 hours on test and was pinched to 50 bbl. day. Wildcat is 24 miles southeast of Porter field, Midland County.

Traverse Discovery Hinted in Mason County

Glen Cain 1 Lauterwasser-Dow NE NW NW 1-19n-17w, Mason County, logged Traverse lime 1,480 ft., water at 1,481-99 ft., and oil pay at 1,603 ft., present total depth. Well recovered 15 bbl. oil in 4 hours on swab after setting packer at 1,599 ft. Testing was continuing on wildcat.

New Pay Seen After Osceola Success

Don Rayburn 1 Beecher N½ SE SW 4-17n-10w, Osceola County, located 1 mile east of developed S-Z Monroe production in Reed City field, completed for 60 bbl. a day after 5,000 gal. acid treatment. Well is producing from 4,168-85 ft. pay in Monroe section, and probably will open several new locations for development.

NEW MEXICO

SOUTHEAST NEW MEXICO

Atlantic Refining Completes Eddy County Discovery

Atlantic Refining Co. 1 State "AE" has been completed as a big Pennsylvanian discovery in southern Roosevelt County. The well is a new pool opener, or long extension north of Allison field, across the county line in Lea County.

The well produced 600 bbl. of oil a day through ¼-in. choke. from perforations at 9,650-62 ft. Total depth was 9,800 ft. Oil gravity and flowing pressures were not reported. Earlier, the well flowed 47 bbl. of oil in 1 hour on drill-stem test, under maximum flowing pressure of 1,300 psi.

Location in NW NW 36-8s-36e, is approximately 2 miles from nearest Pennsylvanian wells in the Allison (North Crossroads on some maps) field. Atlantic owns 67 per cent of the 960-acre joint venture, with Gulf Oil Corp., Magnolia Petroleum Co. and Skelly Oil Co., holding the remaining interest.

Eddy County Wildcat Has Gas Blowout

A gas fire at Union Oil Co. 1-26 Crawford, Eddy County wildcat in 26-24s-26e, consumed the rig and was out of control, according to early reports.

Operators reported a slight show of gas around 9,980 ft., which increased as drilling continued to 10,057 ft. At that depth the well was flowing gas through 11/64-in. choke at the daily rate of 1,080 M.c.f., under surface pressure of 420 psi. Mud was being pumped in to kill the flow when mechanical trouble developed, allowing the gas to blow.

Location of the well is 15 miles south of Carlsbad, and 4 miles south of Black River (Delaware sand) field. It is approximately 10 miles northwest of the Glenn area, where, in 1956, El Paso Natural Gas Co.'s 1-X Welch Unit encountered high-pressure gas in lower Pennsylvanian below 12,000 ft.

In northeastern Eddy County, El Paso Natural 1 Leonard-State, deep wildcat 20 miles east of Artesia in the Grayburg-Kelly field area, was drilling below 10,771 ft., after making a flow of gas and condensate on drill-stem test.

The well is in SW NW 22-17s-29e. The above test was in the Pennsylvanian at 10,734-71 ft. Gas surfaced in 3 minutes and mud with condensate in 45 minutes. Gas flow was at the rate of 5,020 M.c.f. per day, with 6 bbl. of 54°-gravity condensate an hour. Maximum flowing pressure was 1,040 psi., shut-in pressure read 4,525 psi.

Earlier tests in the Pennsylvanian at 10,682-10,734 and 10,638-10,712 ft., also flowed gas and condensate.

Dry Wildcat Reworked Makes Field Extension

C. W. Trainer 1 Reeves, re-entered Lea County failure 13 miles southwest of Lovington, has been completed as the second Pemo-Pennsylvanian producer in Reeves field. Location is 1 mile west of the field discovery.

No. 1 Reeves flowed 253 bbl. of 46°-gravity oil through ⅜-in. choke, from perforations at 10,916-21 ft. Gas-oil ratio was 1,140:1. It was originally drilled in 1954 as Superior Oil Co. 1-23 McAlphin, and was dry at total depth 12,355 ft.

The Reeves field discovery was Cities Service Oil Co. 1-AX State. Potential was 1,022 bbl. of oil a day from pay at 10,945-65 ft.

OKLAHOMA

OKLAHOMA PANHANDLE

New Pay Is Also Oil Discovery at Highland

Highland field in Beaver County has a new pay zone and a first oil producer. United Producing Co. 5 Carlisle, C SE NW 23-3n-28eCM, recovered 400 ft. of oil on a drill-stem test in the Checkerboard-Pennsylvanian at 6,005-30 ft.

Production from the Hoover-Pennsylvanian sand in this well is gas as is the case in other field wells. The 5 Carlisle, when successfully completed, will be a new pay and the first oil well in this field.

Cities Service Will Drill Second Well in Guymon

Location has been made for a 1-mile north offset to Cities Service Oil Co.'s new inside Hugoton field well at 1 Murdock, C NE SW 10-4n-15eCM. The new well is the 1 Vogel-B, C NE SW 3-4n-15eCM. It will go to 6,800 ft. in search of the Morrow-Pennsylvanian sand.

The field discovery well flowed 8,080 M.c.f. of gas per day from the Morrow at 6,060-6,101 ft. Recovery was 2 ft. of condensate.

NORTHWESTERN OKLAHOMA

Major County Wildcat Flows Cottage Grove Gas

Pan American Petroleum Corp. has a new gas field for the northwestern Oklahoma play. The new strike is the 1 Harris Unit in C SE NW 13-22n-16w, Major County. It flowed 9,400 M.c.f. of gas per day from perforations in the Cottage Grove-Pennsylvanian sand at 6,207-71 ft.

This wildcat has been closely watched for several weeks due to its important position in the current Woodward County and other northwestern Oklahoma areas drilling campaign. It is the easternmost anchor in the Morrow and Pennsylvanian trend that is shaping up through Woodward, Ellis, and Harper counties.

Woodward County . . . Meanwhile to the southwest a few miles in eastern Woodward County, Shell Oil Co. has apparently confirmed its new pool at 1 Garvie-B in C SE NW 23-22n-17w. The Chester - Mississippian discovery flowed 1,400 M.c.f. of gas per day on 1-in. choke from perforations at 7,137-64 ft. The discovery well in this new field is in Secttion 26 to the southeast. Location is on the east side of the county near the Major County line.

SOUTHERN OKLAHOMA

Madill Field Well Records High Flow

A high oil flow was reported at a Madill field well in Marshall County. Jones Oil Co. 33 Neff, NW SE SE 24-5s-5e, flowed 650 bbl. of oil in 8½ hours on ⅝-in. choke for perforations in both the second and third Bromide Ordovician sand sat 7,273-7,492 ft. The

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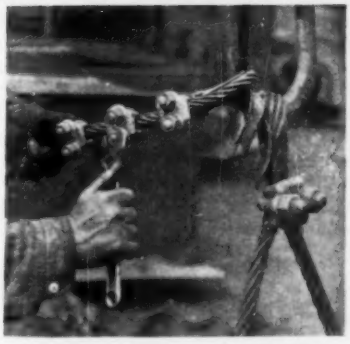

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daily rate would be more than 1,600 bbl.

The well also had commercial showings in the Hunton lime.

ROCKY MOUNTAINS

WYOMING

Phosphoria Discovery In Southeast Big Horn

The southeastern edge of the Big Horn basin has an apparent Phosphoria discovery. The well is Tennessee Gas Transmission Co. 1 Schrantz, C NW NE 33-47n-91w, 2 miles southwest of Cottonwood Creek-Phosphoria production.

A drill-stem test at 10,164-10,221 ft. got 130 ft. of heavily oil and gas-cut mud. The operator swabbed 207 bbl. of oil in 20 hours from perforations at 10,185-10,206 ft. after acid treatment.

The area between this new discovery and Cottonwood Creek field has had no drilling activity. Meyer Gulch-Phosphoria field is located 4½ miles to the east.

Oil Well Completed at Big Piney Field in Sublette

Big Piney gas field in the Green River basin picked up another oil producer at Belco Petroleum Co. B-34, C SW SW 25-29n-113w. The well swabbed 140 bbl. of oil per day. No other information is available.

The well is a north offset to a Gulf Oil Corp. well in SW NW 36-29n-113w, which flowed 104 bbl. of oil in 12 hours from the Mesaverde at 3,250-3,310 ft. Later the well was completed as an Almy sand gas well at 2,989-3,180 ft. for 4,063 M.c.f. daily.

Big Piney is a Mesaverde gas producing field with the Gulf discovery being the first oil productive there.

NORTH DAKOTA

Two Discoveries Reported In McKenzie County

Both Amerada Petroleum Corp. and The Texas Co. reported new Madison discoveries in McKenzie County. The Amerada well is 1 Bear Den Unit in NW NE SE 25-149n-96w, 1½ miles south of Cross-Madison field. It flowed 145 bbl. of oil and 18 bbl. water in 24 hours on 14/64-in. choke from perforations at 9,530-9,605 ft. Testing continues.

The Texas Co. discovery is 7 miles northeast of Croff field at 1 Loomer in C SE SW 6-150n-95w. This one was completed flowing 351 bbl. of oil daily on 17/64-in. choke from Madison, and is the confirmation well to Amerada's 1 Lovaas in C NW NE 6-150n-95w. That one made 337 bbl. per day on 15/64-in. choke. Location 1 mile south of Blue Buttes field.

Lignite Field Development Continues Successfully

Successful development of new Lignite field in Burke County continues. Pan American Petroleum Corp. 1 Holte, C NW SE 5-162n-91w, flowed 12 bbl. of oil per hour on an 8-hour test of Midale-Madison. Perforations are at 6,066-94 ft.

Another well in the field, a northwest extension, is Northern Natural Gas Co. 1-A Bunting in C NW SW 5-162n-91w. It flowed 9 bbl. of oil in 1 hour from perforations at 6,078-6,104 ft.

Three other wells in the area are apparent discoveries. They are: Mobil Producing Co. 1 Noven in C NW NE 8-162n-91w; Petroleum Corp. of America and Tom Jordan 1 Jorgens in C NE NE 28-162n-91w, and Northwest Oil Drilling Co. and Central LeDuc 1 Klitzke in C SW SW 17-163n-91w.

TEXAS

TEXAS PANHANDLE

New Strikes in Palo Duro Made By Shell

Shell Oil Co. has completed its second and third wildcat producing wells in the Texas Panhandle's recently opened Palo Duro basin.

Both discoveries are in Oldham County.

The 1 Alamosa Ranch "B," 11 miles northwest of Vega and 5½ miles southeast of the 1 Alamosa Ranch field discovery well, flowed 612 bbl. of oil daily on a 1-in. choke, natural, from perforations in the Missouri-Pennsylvanian granite wash at 7,122-32 and 7,137-43 ft. Location is Section 13, Block H-3, Capitol Lands Survey.

The second discovery well, 1 L. S. Ranch, 15 miles north of Vega, swabbed 31 bbl. of 43°-gravity oil per day from 8,526-58 ft. in the Des Moines-Pennsylvanian granite wash.

WEST TEXAS

Winkler Wildcat Flows Ellenburger Oil

Another Ellenburger structure for Winkler County was assured at Gulf Oil Corp. 188 Keystone Cattle Co., 9 miles east of Kermit and directly south of shallow Permian production in South Keystone field.

Operators drilled into the Ellenburger at 11,314 ft. A drill-stem test at 11,283-11,364 ft. had oil at the top

Gulf Oil 188 Keystone Cattle Co. has opened Ellenburger production on south flank of South Keystone field. The well had only light gas shows in Wolfcamp and in the Devonian.

in 2 hours and 15 minutes, and over a period of 9½ hours flowed 125 bbl. of 35°-gravity oil, 3 bbl. of mud and 25 bbl. of sediment and water. Bottomhole flowing pressure was 3,900 psi.

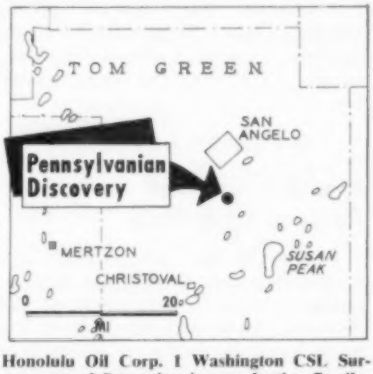
Drilling continued after the test. Contract depth calls for 16,800 ft. Location in Section 9, Block B-6, PSL Survey, is 1¾ miles south of Gulf's Devonian discovery in South Keystone field, and 3½ miles southwest of Circle Two field, which has Ellenburger production.

Pool Opener Completed In Tom Green County

Tom Green County gained a Pennsylvanian discovery at Honolulu Oil Corp. 1 Washington County School Lands, 7 miles south of San Angelo.

Initial potential was 232 bbl. of 35°-gravity oil a day through ⅝-in. choke, from perforations at 4,930-44 ft. Tubing pressure was 200 psi. Location is in League 105, Washington CSL Survey. It is 1½ miles northwest of a 6,105-ft. dry hole and 4 miles northwest of Pecan Station field.

Andrews County . . . Devonian produc-



Honolulu Oil Corp. 1 Washington CSL Survey, opened Pennsylvanian production 7 miles south of San Angelo.

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tion has been indicated at two wildcats in northeastern Andrews County.

The Texas Co. 1-CE University, 1 mile east of Queen sand production in McFarland, South field, flowed 147 bbl. of oil in 12 hours on a test of the Devonian. The prospect kicked off after swabbing 64 bbl. of local oil.

Pan American Petroleum Corp. 2-BZ University, multipay prospect on the east flank of Queen production in McFarland, East field, was swabbing Devonian oil. In a 16-hour period, swabbing recovered 100 bbl. of new oil and 21 bbl. of water, and in 7 hours recovery was 32 bbl. of new oil and 5 bbl. of water. Perforations being worked on were between 12,728-32 ft. and 12,760-70 ft.

Pecos County Depth Holder Scheduled to 21,500 Ft.

Pan American Petroleum Corp. 1-CS University, Pecos County project and depth record holder for the state, was drilling below 20,547 ft. in shale at last report and still looking for the Devonian. Pan American has again filed application to deepen, the last one being from 20,500 to 21,500 ft. Location is in Section 27, Block 23, University Lands Survey, 15 miles southeast of Fort Stockton.

TEXAS GULF COAST

Matagorda Discovery Well Records Large Gas Flow

A wildcat in southwestern Matagorda County is being completed with an open-flow potential of 180,000,000 cu. ft. of gas per day.

The gas is dry. Production is from a relatively shallow sand at 4,022-34 ft. in hole drilled to 5,966 ft. and cased to 4,083 ft. Shut-in pressure is 1,688 psi.

The well was drilled by Southern Minerals Corp. and Colvin & Waters on a 10,635-acre lease in the Ralph Wright Survey. Location at 1 LeTulle, is about 5 miles south of Palacios. It is only 660 ft. from the shoreline of Matagorda Bay.

Matagorda County recorded another gas discovery during the week. It was made by Gulf Oil Corp. in an outpost test a mile nohtheast of nearest production in Wadsworth field, 8½ miles southeast of Bay City. The well, 1 Baker, in I&GN Survey, A-297, was completed in a Frio sand, perforated at 9,762-80 ft. It is rated good for 40,000,000 cu. ft. of gas per day, open flow. Tested through an adjustable choke, it flowed 2,466,000 cu. ft. per day under pressure of 3,330 psi. Liquid (58.3°-gravity condensate) was in the ratio of 22,800 cu. ft. of gas per barrel.

Refugio County Wildcat Completed as Producer

Hoxsey Oil Co.'s new discovery well in the far northeastern corner of Refugio County flowed 76 bbl. of 50°-gravity oil per day through 7/64-in. choke for its potential gage.

The well, 1 Landgraf, 2 miles northeast of Tivoli, in the Pierce Rollins Survey, opens a new field, 4 miles from nearest other production (Tivoli field). However, its north offset, 1 Weise, found the discovery well's 5,550-ft. Frio sand commercially unproductive, and has been abandoned.

Other developments in northern Refugio County last week included the opening of another pay zone in West Lake Pasture (Vidauri) field, northeast of Vidauri. The new-pay discovery is in the field's second well, drilled by T-C Oil Co., of San Antonio.

The well, 1-G Dennis O'Connor, southeast offset of the initial well, is rated at 32,000,000 cu. ft. of gas per day, open flow. Gas is dry. Shut-in pressure is 1,667 ft.

Pay is perforated at 4,144-46 ft. The discovery well, drilled by F. William

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DALLAS 6, TEXAS

Carr, and completed last April, is perforated at 5,919-21 ft. It also was a gasser.

TEXAS GULF COAST

Fairbanks Area Wildcat Opens New Yegua Field

Oil production is indicated in a wildcat drilled by Currie B. Davis & Co., of Houston, about 1½ miles north of Fairbanks field and about a mile northwest of North Houston field, in Harris County.

Nearest producer at Fairbanks field is the new-pay and north side extension well completed last August by Armour Properties and Wesley West.

The latter well proved productive in a Yegua sand, perforated at 6,695½-98½ ft. The Davis discovery well is testing Yegua sand at 6,700-03 ft. Although no gage of productivity is reported it flowed oil. Through 9/64-in. choke, pressure was 500 psi.

Armour and West are testing their second well at Fairbanks to confirm their new Yegua-sand discovery. Their 2 Davis and others, about 933 ft. southeast of their initial well (1 Davis and others), flowed 24 bbl. per day with pay perforated at 6,693½-94½ ft. Operators plan to reperforate a little lower in the pay and retest before final completion as present perforations are at the top of the sand.

OREGON AND WASHINGTON

Standard-Western, G.P. Drilling Ahead in Northwest

● General Petroleum Corp. was drilling below 7,600 ft. on its wildcat in the Sulphur Springs area of Douglas County in Oregon.

Standard Oil Co. of California Western Operations, Inc., was drilling ahead below 3,443 ft. on 1 Rattlesnake Hills Unit in Benton County, Washington.

Successful Wildcats

CALIFORNIA

Kern County: McCulloch Oil Exploration Co. of California, Inc., 2 McCulloch-DiGiorgio, NE NW 10-31s-29e, 133 BOPD, 30° gravity, 2.6 per cent cut, 14/64-in. choke, perfs. 6,030-6,267 ft. TD 6,267 ft. (New pool discovery on the east flank of the main Mountain View field area.)

ALBERTA

White Rose et al 11-3 Innisfail, LSD 11, 3-35-1w. D3 oil discovery. TD 8,732 ft.

Colorado et al 19-20 Normandvile, LSD 13, 20-79-22w5. Mississippian oil well. TD 7,600 ft.

T.G.T. 1-20-28-2 West Crossfied, LSD 1, 20-28-2w5. Indicated Mississippian oil discovery. TD 8,708 ft.

Canso et al 16-35 Cook, LSD 16, 35-31-22w3. Viking gas discovery. TD 2,260 ft.

BRITISH COLUMBIA

White Lloyd-Fargo 16 Blueberry, LSD 46-D-94-A-13. Mississippian oil discovery. TD 7,277 ft.

SASKATCHEWAN

White Rose-Devon-Palmer-Canadian Superior 16-3 Adelaide, LSD 16, 3-10-1w2. Mission Canyon oil discovery. TD 3,700 ft.

British-American-Calvan 5-27 Palmer, LSD 5, 27-5-3w2. Mississippian oil discovery. TD 4,134 ft.

SOUTH LOUISIANA

Evangeline Parish: Humble Oil & Refining Co. 1 Lahaye, 38-5s-1e (3 miles east of Mamou field). IP 109 BOPD, 3/16-in., GIR 8,314 cu. ft. per bbl., 50.7°, perforations 11,632-41 ft. TD 12,457 ft. (New field.)

Jefferson Davis Parish: Texas Pacific Coal & Oil Co. 1 Louisiana Rice Milling Co., 41-9s-3w (2½ miles west of Jennings field). IP 1,850 M.c.f. daily and 11 BOPD, 5/32-in., 46.8°, TP 3,750 psi. (New field.)

Continental Oil Co. 2 Quatre Parish Co., 26-7s-7w. IP 1,100 M.c.f. daily, 3/16-in., dry gas, TP 1,240 psi. Perforations 2,885-95 ft. TD 2,971 ft. (New pay and second well in Thompson Bluff field.)

Lafayette Parish: Monsanto Chemical Co. 1 Bayou, 24-10s-5e. IP 302 BOPD and 3,000 M.c.f. daily, 5/32-in., 60°, TP 5,700 psi., perforations 13,510-18 ft. TD 14,554 ft. (New pay and second well in Broussard field.)

COLORADO

Moffat County: The Texas Co. 8 Maudlin Gulch, SE SW NE 27-4n-95w. IPP 22 BOPD, Weber-Penn discovery, new pay. OWDD. TD 8,386 ft.

NEBRASKA

Kimball County: Claude Wentworth Drilling Co. 1 Shaw, C NE NE 33-14n-54w. IPP 158 BOPD, "J" sand discovery, new field. TD 6,075 ft. Skull Creek.

NORTH DAKOTA

Burke County: Carter Oil Co. 1 State-Tande, C SW SW 16-159n-94w. IPP 66 BOPD, 12 BWPD, Madison discovery, new field. TD 8,050 ft. Madison.

Texota Oil Co. 1 Sorum, C SE SE 23-163n-91w. IPP 80 BOPD, Nesson discovery, new field. TD 6,297 ft. Nesson.

1 Wolkenhauer, C SW NW 33-164n-90w. IPP 96 BOPD, Midale discovery, new field. TD 5,942 ft.

WEST TEXAS

Andrews County: Champlin Oil & Refining Co. 1 University "M," Sec. 6, Blk. 1, University Lands, 6½ mi. S Andrews. IPP 223 BOPD, 35-gravity, GOR 897, Pennsylvanian 8,951-9,091 ft. TD 9,221 ft., elev. 3,179 ft.

Delhi-Taylor Oil Corp. 1 Lotus Oil Co., Sec. 23, Blk. A-48, PSL, 18 mi. W Andrews. IP 264 BOPD, ⅜-in., 27-gravity, GOR 436, TP 100 psi., Grayburg 4,530-51 ft. TD 7,230 ft., elev. 3,285 ft.

Continental Oil Co. 1 Teague, 1-A44-PSL Sur: 3 mi. SE Andrews. IP 1,345 BOPD, 32/64-in., 37-gravity, GOR 1300, TP 435 psi., Wolfcamp perforations 8,783-8,823 ft. TD 13,520 ft., elev. 3,135 ft. Formation tops: Devonian 11,742 ft., Fusselman 12,690 ft., Ellenburger 13,437 ft.

Culberson County: Ford Chapman & Associates 1 TXL, Sec. 35, Blk. 58, T1, T&P Sur., 10 mi. NW Orla. IP 66 BOPD, 8/64-in., 44-gravity, GOR 650, TP 400 psi., Delaware 2,552-58 ft. TD 2,558 ft., elev. 3,021 ft.

Glasscock County: Shell Oil Co. 1 Currie, 24-34-T3S-T&P Sur., 6 mi. N Garden City. IP 327 BOPD, ¼-in., 43-gravity, GOR 1130, TP 875 psi., Wolfcamp 8,554 ft. TD 10,621 ft., elev. 2,737 ft.

Pecos County: George T. Abell 1 State Corrigan "A," 14-3-H&TC, 1½ mi. S Imperial. IP 155 BOPD, ¼-in., 41-gravity, GOR 466, TP 220 psi., Waddell 6,090-6,100, 6,077-85 ft. TD 6,112 ft., elev. 2,403 ft.

SOUTHWEST TEXAS

McMullen County: Peat Oil Co. 6 Ezzell, Section 56, Hays Ezzell Subd., S. M. Hodges Sur., A-773. IP 1,950 M.c.f. daily, absolute open-flow potential, GIR 108.8 M.c.f. per bbl., 57.6°, shut-in tubing pressure 1,936 psi., perforations 5,063½-67½ ft. (Queen City). TD 5,025 ft. (Extends Clayton field.)

Humble Oil & Refining Co. 2 J. C. Dilworth, Jr., Rafael Vasquez Sur. 42, A-486. IP 36,500 M.c.f. daily, absolute open-flow potential, GIR 175 M.c.f. per bbl., shutin tubing pressure 4,255 psi., perfs. 10,670-65 ft. (Edwards lime). TD 11,471 ft. (New deep Edwards field.)

TEXAS GULF COAST

Chambers County: Humble Oil & Refining Co. 76-A State-Galveston Bay, Section 245, Galveston Bay. IP 11,800 M.c.f. daily, absolute open-flow potential, GIR 34.8 M.c.f. per bbl., 55.4°, perforations 11,199-11,215 ft. (Frio). TD 11,560 ft. (New pay and southeast extension in Red Fish Reef field.)

Jackson County: C. C. Winn 1 Hollingsworth, Eli Mencer Sur., A-54. IP 36,000 M.c.f. daily, absolute open-flow potential, dry gas, shut-in tubing pressure 1,746 psi., perforations 4,221-25 ft. (Frio). TD 4,450 ft. (New reservoir in Morales gas area.)

Nueces County: Ramada Oil & Gas Co. and F. B. Cochran, Jr., 6 Hoting, Section 144, Braniger Brothers Subd., Clarkson Ranch. IP 65.52 BOPD (net), 30 per cent water, 5/32-in., 22.2°, TP 140 psi., GOR 120 cu. ft. per bbl., perforations 3,260-65 ft. (Oakville). TD 3,550 ft. (New pay in Ramada field.)

Republic Natural Gas Co. and Forrest Oil Co. 4 State, Tract 786, Nueces Bay. IP 17,300 M.c.f. daily, absolute open-flow potential, GIR 18.5 M.c.f. per bbl., 50.5°, shut-in tubing pressure 4,810 psi., perforations 9,692-9,702 ft. (Frio). TD 9,845 ft. (New pay in Indian Point field.)

Refugio County: T-C Oil Co. 1-G Dennis O'Connor et al, Power & Hewitson Sur., A-53. IP 32,000 M.c.f. daily, absolute open-flow potential, dry gas, shut-in tubing pressure 1,667 psi., perforations 4,144-46 ft. TD 6,000 ft. (New pay in West Lake Pasture field.)

Wharton County: Associated Oil & Gas Co. 1 Emil Hillje et al, WCRR Sur. 39. IP 6,500 M.c.f. daily, absolute open-flow potential, dry gas, shut-in pressure 2,068 psi. perforations 5,031-38 ft. (Frio). TD 5,170 ft. (New pay and deepest producer in Trans-Tex field.)

Pecore works his way to . . .

Top Man at Humble Pipe Line

BACK ABOUT the end of World War I, new companies were springing up almost daily in the oil industry. Many of them were mere stock promotions with assets consisting mainly of "blue sky" leases. Some of them didn't survive long enough to get out their first annual report.

So it was with some hesitation that A. E. Pecore, newly discharged veteran, took a job with one of these new companies. Pecore hesitated partly because he knew very little about the company and partly because he was in no hurry to go back to work.

"I promised myself a month's vacation when I got out of the army," he recalls. But he never took it.

Pecore returned to his native Houston one Friday in the summer of 1919. The next day he was offered a job by an outfit with a very unpretentious name—Humble Pipe Line Co. He did some fast checking and was advised that the company might offer some opportunity for a young man. The following Monday, rather reluctantly, he went to work for the Humble people.

"Before the war I'd never heard of them," he says. Humble Pipe Line was organized just a few months earlier, while Pecore was still overseas. And the parent firm, Humble Oil & Refining Co., was just starting its third year in business.

Now, after 38 years with the company, Pecore has been named president. He succeeds O. Q. Lomax, who is retiring at the end of the month after 7 years in the presidency.

The way up . . . Pecore, a registered professional engineer, got to the top without a college degree. But it took him many nights of study on correspondence and extension courses.

It was discontent with his job as a railroad clerk that prompted him to study drafting before World War I. His training, plus a natural skill in drawing, brought him a prewar job in the engineering department of Producer's Oil Co., which later merged into The Texas Co. He continued correspondence courses while with Producer's, then resumed his home studies after the war while working for Humble.

He became chief draftsman for Humble Pipe Line after 5 years. Later promotions made him assistant civil engineer and chief engineer. In 1949, then in his middle 50's, Pecore returned to school—this time to attend the Advanced Management Program at Harvard University. While there he was promoted to general superintendent of Humble Pipe Line. The following year he became vice president.

A. E. PECORE
. . . In pipeline automation, opportunity.

The future . . . Now 62 years old, Pecore has spent nearly two-thirds of his life in the pipeline business. Looking both ways from his vantage point, Pecore is convinced that he can see even greater opportunity for young men in the industry now than 38 years ago.

"Rather than becoming stagnant, I think it's growing all the time," he says.

In fact, Pecore explains, pipelining is now in the early stages of one of its greatest advancements. That development—automation—may cut down on operating crews, but it will demand more specialists in maintenance who can command higher pay.

Pecore sees automation as a movement which will create far more opportunities than it destroys.

"After all, somebody has to make these instruments; somebody has to service them."

Carle S. Boyer and **Glen M. Ford** have been appointed assistant division geologists in The Texas Co.'s Oklahoma division, producing department. They will headquarter in Tulsa. Boyer has been on the chief geologist's staff of Texaco's Houston division for the past 2 years. He was district geologist in Sterling, Colo., before that time. Ford has been senior geologist in the Oklahoma division.

Personals

Leon O. Wiringa, Shell Oil Co.'s area geologist in Calgary, has been appointed senior geologist in Denver

C. J. Ladas and **M. J. Wachel** have been appointed exploitation engineers for Shell Oil Co. in Woodward, Okla.

Tom Purcell has joined Tennessee Gas Transmission Co. in Casper, Wyo., as a geologist. Purcell is a graduate of the University of Oklahoma.

James D. Engel, petroleum engineer with Carter Oil Co., has been transferred to Oklahoma City from Seminole, Okla.

Leon F. Nixon, junior corrosion engineer for Panhandle Eastern Pipe Line Co. in Paola, Kans., has been transferred to Glenarm, Ill., as corrosion engineer. He replaces **L. T. Church,** who will retire in November.

Ronald A. Baker has been named manager of the technical department in General Petroleum Corp.'s manufacturing department. **Paul A. Rene** has been appointed manufacturing and economics planning manager.

Richard C. Loring, production superintendent with W. C. McBride, Inc., has been transferred from San Antonio, Tex., to Tulsa, where he will be superintendent of the Texas and Oklahoma-Kansas districts.

Robert C. Hagens has resigned as production superintendent of American Petrofina, Inc., in Corpus Christi, Tex., to join Colona Oil & Gas Co., a new Corpus Christi firm, as drilling and production superintendent.

R. S. Manne has been appointed senior research chemical engineer in the research and devolpment division at Humble Oil & Refining Co.'s Baytown, Tex., refinery. **T. J. Loughridge** has been promoted to senior supervising engineer, **G. H. Ferguson, Jr.,** to supervising engineer, and **R. E. Burns,** to senior mechanical engineer in Humble's engineering division at Baytown.

William A. Reaman has been appointed manager of International Petroleum Co.'s new Cartagena refinery in Colombia. The refinery will go on stream in December. Reaman succeeds **H. Curtis Carroll** as manager. Carroll, who supervised planning and construction of the new refinery, is retiring after 28 years with International.

Personals

J. J. LAWNICK

Joseph J. Lawnick, assistant chief petroleum engineer for La Gloria Oil & Gas Co., Corpus Christi, Tex., has resigned to join American Petrofina, Inc., in Corpus Christi as drilling and production superintendent. A graduate of the University of Oklahoma, Lawnick was with Shell Oil Co. before joining La Gloria.

G. H. Rowe, assistant drilling superintendent for Cascade Drilling Co., has moved up to drilling superintendent. He succeeds **F. H. Allen,** who has retired.

C. F. Olson has been transferred by McAlester Canadian Oil Co. from Billings, Mont., to the company's new Regina office, where he will be district geologist.

James R. Britt has been named general manager of Procon (Great Britain) Ltd., with headquarters in London. he succeeds **Charles B. Robbins,** who has returned to Procon's home office in Des Plaines, Ill., as assistant to the president.

C. W. Blakey has been appointed vice president in charge of foreign operations outside of Canada by Century Geophysical Corp., Tulsa. **Robert A. Broding** has been named technical vice president and **J. L. Friendly** appointed manager of domestic seismic operations.

Dr. J. F. Horner and **Dr. H. D. Radford** have been promoted to assistant directors of research in American Oil Co.'s research and development. Both were formerly section heads in process development. In other appointments, **W. F. Johnston** and **E. A. Siegman,** senior engineers, have moved up to section heads. **W. A. Davies,** associate chemical engineer, has been promoted to group leader in the development section.

Alphonse L. Parmer has joined the southwestern region, production and exploration department, of Lion Oil Co. Division of Monsanto Chemical Co. **Hugh W. Howard** has joined Monsanto's plastics division in Springfield, Mass., and **Fred W. Obermann** is a new member of the company's technical services department, organic chemicals division, St. Louis.

James H. Gardner has resigned as contract representative for Garvey Drilling Co. to join Osage Oil & Gas Co., Inc., Wichita, as vice president.

Neil O. McDaniel has left Champlin Oil & Refining Co., where he was district engineer in Sinton, Tex., to join Continental Oil Co. as production engineer in Lyons, Tex.

Harold Williams, formerly assistant foreman for The California Co. in Brookhaven, Miss., has been promoted to field foreman and transferred to Magee, Miss.

John A. Weideman has resigned as petroleum engineer with Continental Oil Co. in Hobbs, N. M., to open consulting offices there.

W. W. Ramseur has been promoted by Gulf Oil Corp. from zone production superintendent in New Orleans to district manager in Jackson, Miss.

Wayland V. Jordan, production engineer for Continental Oil Co. in Big Spring, Tex., has been promoted to district production engineer and transferred to Ozona, Tex.

J. C. Magner, assistant vice president of Rowan Drilling Co., Inc., Fort Worth, has been named chairman of the Dallas-Fort Worth regional chapter of the American Association of Oilwell Drilling Contractors. **C. I. Holliman,** president of Holliman Drilling Co., Dallas, is new vice chairman, and **John W. Rhea, Jr.,** vice president of Southeastern Drilling Corp., Dallas, new secretary-treasurer of the chapter.

H. G. Denham, president of Mid-East Crude Sales Co., Ltd., affiliate of California Texas Oil Co., Ltd., has moved up to chairman of the board. **L. H. Nuland,** shareholders' representative of Caltex Oil (Australia) Pty, Ltd., in Sydney, Australia, will replace Denham as president of Mid-East. **J. A. Triska,** assistant to the president of Mid-East, has been named vice president.

Seven directors were elected by the Canadian Association of Oilwell Drilling Contractors at the annual meeting in Calgary. They include **J. S. Hunter,** Hunter Drilling, Ltd.; **W. B. Crutcher,** General Petroleums of Canada, Ltd.; **S. W. Shambaugh,** Reading & Bates Drilling Co., Ltd.; **Ray Tull,** Cambridge Corp., Ltd.; **F. T. Glasscock,** Pennant Drilling, Ltd.; **William Booth,** Commonwealth Drilling Co., Ltd.; and **David K. Gunderson,** Regent Drilling Co., Ltd.

D. L. Tinsley, tool pusher, has been transferred to Houma, La., from Kinder, La., by Penrod Drilling Co.

John R. Riley, production engineer, has been transferred to Denver from Cody, Wyo., by Pan American Petroleum Corp.

Jerry C. Funderburk, Jr., petroleum engineer with Gulf Oil Corp., has been transferred to Houston from Thompsons, Tex.

Thomas Trinker, technologist at Shell Oil Co.'s Norco, La., refinery, has been temporarily transferred to Houston as research engineer at the company's refinery there.

Quentin M. Moore has been transferred by General Petroleum Corp. from Bakersfield, Calif., where he was resident geologist, to Los Angeles where he will be coordinator of exploration in the Los Angeles Basin.

J. L. IRVIN

J. L. Irvin has been elected president of Gulf Refining Co. in a change which brought election of five new officers and directors to the pipeline subsidiary of Gulf Oil Corp. Other new officers are **W. L. Shannon,** vice president; **M. W. Ramsey,** vice president; **G. W. Conrad,** comptroller-treasurer; and **Robert Carter,** secretary. New directors are **Walter Clemons, S. O. Tostengard,** Irvin, Shannon, and Ramsey. Irvin has been general manager of the company for the past year. Shannon was manager of domestic operations. **W. K. Whiteford,** president of the parent company, was formerly Gulf Refining Co. president.

Arthur E. Dietert has been appointed Cities Service Oil Co.'s representative on the C.A.T.C. management committee. He will headquarter in Houston. Dietert has been on special assignment for the company in Italy for the past several months. He was formerly southwestern division geologist in Fort Worth.

William H. Woods has been elected vice president of Runnels Gas Products Corp., subsidiary of Union Oil & Gas Corp. of Louisiana. He will continue as superintendent of the gas department for the parent company. Woods joined Union in 1952. Before that time he was division gas engineer for Gulf Oil Corp.

Phillips Researchers Set Safety Record

A Distinguished Safety Achievement Award is accepted by J. A. Reid, right, director of research for Phillips Petroleum Co., in recognition of the research division's completion of 7 million man-hours of work without a disabling injury. The award was presented by Paul Endacott, left, Phillips president. The record stretches over 10 years. It is the best safety performance of any group within Phillips and ranks high among leaders for industrial-research workers.

Evan Watts, seismic party chief for Magnolia Petroleum Co., has been transferred to Pecos, Tex., from Breckenridge, Tex.

J. M. Tharp, Jr., has been promoted by Tidewater Oil Co. from assistant area superintendent in Ventura, Calif., to district superintendent in Los Nietos, Calif.

Ralph E. Albright has joined the product-development department of California Texas Oil Co., Ltd., in New York. He was formerly assistant to the director of Socony Mobil Oil Co.'s product-development division in Paulsboro, N. J.

John W. Gregg, petroleum engineer with New Superior Oils of Canada, Ltd., has been appointed general manager and vice president of the company. A native of Medicine Hat, Alta., Gregg is a graduate of the University of California.

Robert W. Otto, chairman of the board, Laclede Gas Co., has been nominated for president of American Gas Association. A.G.A. officers will be elected at the annual meeting, October 7-9 in St. Louis. **A. W. Conover,** president of Equitable Gas Co., had been nominated for president but withdrew because of illness. Instead, he will run for first vice president. Otto had formerly been the first vice presidential candidate.

Frank E. Coupal, exploitation engineer with Shell Oil Co., has been transferred from Glendive, Mont., to Houston as geologist.

Garrett Jupp has been promoted by Sun Oil Co. from petroleum engineer in Beaumont, Tex., to geologist in Lafayette, La.

James M. Taylor, production engineer with Carter Oil Co. in Magnolia, Ark., has joined Don Johnston Drilling Co. in Denver as drilling engineer.

Harry V. Spooner, formerly with The California Co. in New Orleans, has joined Colorado Oil & Gas Corp.'s geological department in Shreveport, La. Spooner is a graduate of the University of Oklahoma.

James C. Donnell II, president of Ohio Oil Co., and **Robert F. Windfohr,** Fort Worth independent, will receive Distinguished Service Awards at the Texas Mid-Continent Oil and Gas Association's annual meeting at Fort Worth in October.

Arthur J. Wessely has resigned as senior geologist in the engineering and consulting department of Core Laboratories, Inc., to join H. J. Gruy & Associates, Dallas petroleum consultants. Wessely had been with Core Lab for 2 years and before that was on the geological staff of Sun Oil Co. in Dallas.

Personals

T. J. Kennedy, petroleum engineer, has been transferred to Oklahoma City from Wilson, Okla., by Magnolia Petroleum Co.

James P. Foraker, Sohio Petroleum Co.'s district exploration superintendent in Wichita, has resigned to become an independent operator there.

Richard B. Palmer has been promoted to staff geologist in Houston for The Texas Co. Palmer was formerly district geologist in Bakersfield, Calif.

Paul D. May has been named senior chemist in American Oil Co.'s research and development department. He has been with Amoco since 1945.

Sam Keene, tool pusher, has joined Penrod Drilling Co. in Shreveport. He was formerly with Zapata Off-Shore Co. in Houston.

William L. Bolles has been named engineering manager in the engineering department of Lion Oil Co. Division of Monsanto Chemical Co. He will transfer to El Dorado, Ark, from Texas City, Tex., where he has been assistant manager in charge of process design in Monsanto's plastics division since 1954.

James McDonald has been appointed administrative manager of manufacturing for Tidewater Oil Co. with headquarters in San Francisco. With the administrative vice president of manufacturing, McDonald will help plan, develop, and coordinate Tidewater's refining interests. McDonald has been assistant manager of the company's new Delaware City, Del., refinery since 1956. He was assistant process superintendent at the company's Bayonne, N. J., refinery before transferring to Delaware City.

Harold Scheeline, director of Esso Research & Engineering Co.'s chemical development department, Linden, N. J., has been appointed assistant manager in the office of refinery liaison. Scheeline has been on special assignment for the past year. **Stan Jaros,** acting director of chemical development, moves up to director replacing Scheeline. **Dan Maisel,** acting assistant director, has been named assistant director.

Personals

D. M. KRAUSSE

Dan M. Krausse, manager of Cosden Petroleum Corp.'s refining division, and **Marvin M. Miller,** head of the producing division, have been named senior vice presidents of the company. **Richard M. Johnson,** sales director, has been named a vice president. Krausse has been with Cosden since 1949; Miller joined the company in 1928.

Floyd Scott, geophysicist for Pan American Petroleum Corp., has been transferred to Bismarck, N. D., from Casper, Wyo.

J. C. Coogan has joined Durbin Bond & Co., Inc., Little Rock, Ark., as petroleum engineer. He was formerly district engineer with Sohio Petroleum Co. in Tyler, Tex.

Lynn D. Erwin has joined Tennessee Gas Transmission Co. as head of the geophysical department in Houston. Erwin was formerly a consultant in Oklahoma City.

Joseph L. Ward, junior exploitation engineer for Shell Oil Co. in Houston, has been promoted to exploitation engineer and transferred to the company's Billings, Mont., division.

Rex K. Davis, general superintendent of Hope Producing Co., has joined McKamie Gas Cleaning Co., Magnolia, Ark., as manager. A graduate of Kansas State College, Davis was with Carter Oil Co. before joining Hope last year.

G. J. Tankersley has been elected president and a director of Western Kentucky Gas Co. Tankersley was formerly executive vice president and a director of Gas Light Co. of Columbus, Ga. He will move to Owensboro, Ky., as president of Western Kentucky Gas Co. November 1.

T. C. Johnson, area supervisor of Sohio Pipe Line Co.'s Tri-State division, has been named group supervisor of construction in the engineering section. He will headquarter in St. Louis. Johnson joined Sohio in 1948. He was line supervisor in the products-line division before becoming Tri-State supervisor in 1954.

Bruce Tegge, Bill Catterall, and **Steve Perry** have been named engineering associates by Esso Research & Engineering Co., Linden, N. J. **Boyd Hudson** has been appointed research associate.

Tyler Brinker, drilling engineer with Union Oil Co., has been transferred to Houma, La., from Abbeville, La.

David H. Mortlock, assistant manager of Arabian American Oil Co.'s manufacturing and oil-supply department, has been transferred to International Petroleum Co., Ltd., as economics advisor to the executive representative's office in Bogota, Colombia.

Alexander Fraser, retired president of Shell Oil Co., has been named executive secretary of the 25 Year Club of the Petroleum Industry. He will fill out the unexpired term of the late H. T. Ashton. Fraser is a past president of the club.

F. T. Connolly has been promoted to senior geologist for Shell Oil Co. in Tulsa.

Stanley C. Paviak has joined Gulf Research & Development Co.'s petrochemicals department.

Alfred J. Rutkowski has joined Esso Research & Engineering Co. at Linden, N. J., as a research chemist.

W. D. (Buck) Davidson, field superintendent with Sharples Oil Corp., has been transferred to Spearman, Tex., from Rangely, Colo.

L. W. Kopel has been transferred by D-X Sunray Oil Co. from Madison, Wis., to Tulsa where he will be assistant manager of operations.

William E. Slaughter, Jr., president of Aurora Gasoline Co., has been reelected chairman of the Michigan Petroleum Industries Committee. **John W. Southworth,** Michigan district manager for Shell Oil Co. at Detroit, was reelected vice chairman.

DEATHS

Gaither L. Jones, 72, Houston independent oil operator, died September 22 in Houston. Jones' career in the oil industry went back to Spindletop where, as a 17-year-old roustabout, he helped build firewalls around tanks in the Beaumont field soon after the discovery well was brought in. In 1907, Jones joined Gulf Oil Corp. He rose to executive assistant to the vice president in charge of Texas operations before becoming an independent in 1921. In 1926 he joined Humble Oil & Refining Co., but left them in 1931 to turn independent again. Most of his operations as an independent were in Louisiana where he sold the fabulous LaFitte field near New Orleans to The Texas Co. in the 1930's.

Jesse W. Rayborn, 60, Tulsa, automotive supervisor for Tidewater Oil Co., died September 19 in Cairo, Ill., after a heart attack. Rayborn was with Sinclair Oil & Gas Co. and the old Mid-Continent Petroleum Corp. before joining Tidewater in 1921.

Weston C. Kimball, 53, Houston, vice president of Apache Exploration Co., died September 21 at his home in Houston. Kimball was with The Texas Co. before joining Apache.

H. G. Cornew, 60, special representative in the foreign-trade department of Standard Oil Co. of California, died September 17 in San Francisco. Cornew joined Socal in 1924. He was company representative in Latin America from 1939 to 1950.

Paul P. Daniel, 63, founder and chairman of the board of Daniel Orifice Fitting Co., died September 19 in Newport Beach, Calif. Daniel was with Standard Oil Co. of California and E. L. Doheny before forming his own company in 1932.

Donald W. Green, 50, partner in Green & Heiser Drilling Co., Bakersfield, Calif., and **Velton Walker,** 36, tool pusher were killed last week when Green's light plane crashed into the Pacific Ocean at Coos Bay, Ore.

Thomas Craig Thompson, 63, Abilene, Tex., consulting geologist since 1938, died September 21 in Abilene. Thompson was a 1921 graduate of the University of Oklahoma.

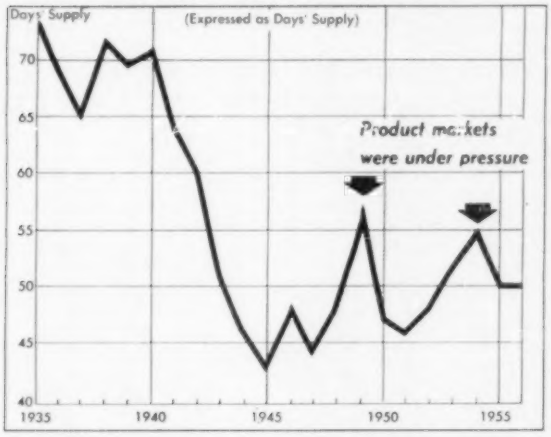
F. B. Howland, 84, retired general manager at Titusville, Pa., for Kewanee Oil Co., died September 23 in Southern Pines, N. C.

Latest Figures . . . Industry Trends

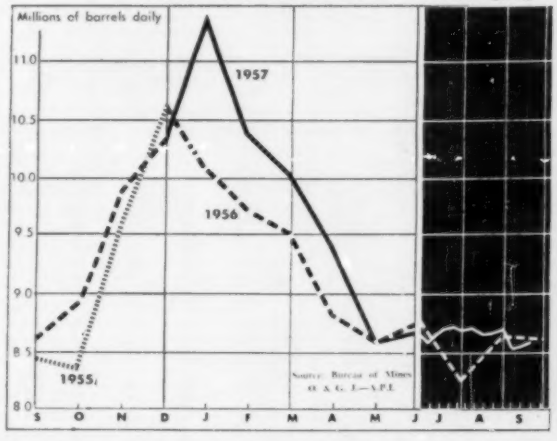
A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,850,800	UP	39,460	DOWN	216,170
Crude stocks	282,096,000	DOWN	386,000	UP	7,667,000
Completions	1,086	UP	29	UP	11
Refinery runs	7,830,000	DOWN	226,000	DOWN	211,000
Gasoline stocks	174,058,000	UP	253,000	DOWN	2,886,000
Kerosine stocks	36,335,000	UP	334,000	UP	2,678,000
Distillate stocks	165,137,000	UP	2,284,000	UP	16,321,000
Residual stocks	56,003,000	UP	820,000	UP	8,168,000
Four-product stocks	431,533,000	UP	3,691,000	UP	24,281,000
Total imports	1,501,900	UP	169,400	UP	137,100

REFINED PRODUCT STOCKS



TOTAL DEMAND—ALL OILS



Fourth Quarter Refinery Runs Should Be Held to 7,900,000 Bbl. Daily

THERE'S AN OLD market axiom which refiners should use as a guide in planning refinery runs for the fourth quarter. That axiom is, "When product stocks are too high, product markets are under pressure."

The above chart shows refined-product stocks expressed as days' supply. The average month-end total for refined product stocks was divided by the daily average demand for the year. Note that there have been two peaks in recent years, one in 1949 and the other in 1954.

For the early period, the big increase in stocks started in 1948 and was reflected in low prices for most of 1949. The second buildup was more gradual, and the pressure on prices was not as severe as in 1949. But, there was a definite reaction to the high stock level.

Refiners filled most of the available product storage in the first three quarters of 1956, but export demand for light and heavy fuel prevented a crisis in the fourth quarter. The product stock reduction was only 16,000,000 bbl. in the fourth quarter, but the outlook for export sales was bright enough to prevent dumping on the fuels market.

Total stocks of refined and natural-gas products will be at an all-time high at the end of September this year, probably in excess of 560,000,000 bbl. The total last year was 530,230,000 bbl. at the end of September but continued to rise until the end of October.

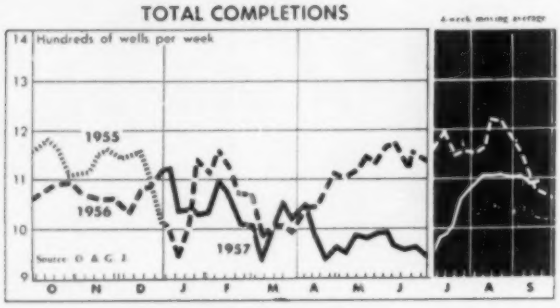
Most refiners will agree that product stocks are too high and that the winter's demand could be met even if the backlog were smaller than last year. To compensate for the excess, refiners will need to hold refinery runs down at least to the level of the fourth quarter of last year. That was 7,926,000 bbl. daily.

Better markets will result if runs are cut below 7,800,000 bbl. daily early in the quarter, leaving room for higher input in December.

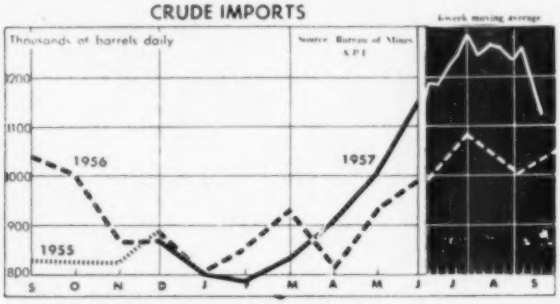
Assuming demand of 9,926,000 bbl. daily in the fourth quarter and 1,390,000 bbl. daily supplied from product imports and gas liquids, product stocks could be cut 46,000,000 bbl. in the fourth quarter.

Such a reduction wouldn't guarantee stable markets in the first quarter of 1958, but anything less is almost certain to add to the pressure on prices.

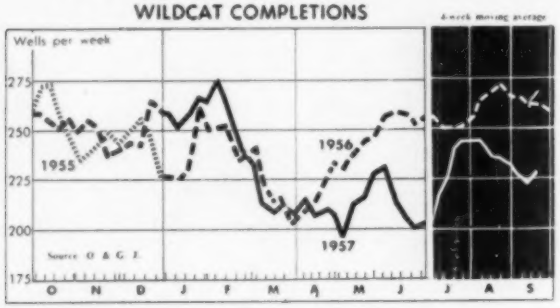
TOTAL COMPLETIONS



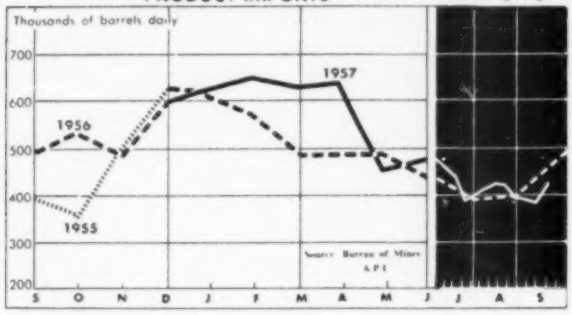
CRUDE IMPORTS



WILDCAT COMPLETIONS



PRODUCT IMPORTS

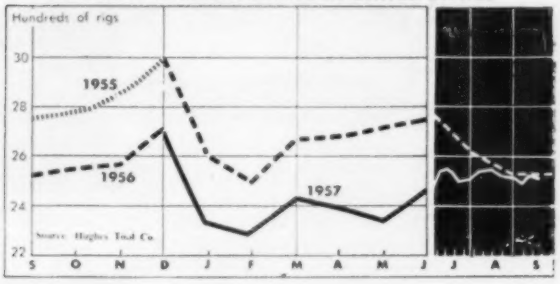


WEEKLY WELL COMPLETIONS . . . WEEK ENDED SEPTEMBER 21, 1957

	Total wells							Cumulative		Total wildcats					Cumulative	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1957	1956	Total	Crude	Cond.	Gas	Dry	1957	1956
Alabama	1	1	0	0	0	0	11,534	64	‡79	0	0	0	0	0	20	‡35
Arkansas	23	18	0	0	5	0	74,590	807	643	6	0	0	0	6	146	138
California	47	37	0	0	10	0	186,403	1,566	1,623	6	1	0	0	5	378	380
Colorado	19	6	0	0	13	0	105,350	618	859	9	1	0	0	8	412	455
Illinois	68	31	0	0	37	0	161,799	1,879	2,792	23	4	0	0	19	469	547
Indiana	6	4	0	0	2	0	13,883	463	493	0	0	0	0	0	92	103
Kansas	66	24	0	1	35	6	240,854	3,034	3,649	13	2	0	0	11	607	782
Kentucky	31	14	0	0	17	0	37,831	1,057	1,336	7	0	0	0	7	219	311
Louisiana	107	46	9	10	41	1	884,500	2,762	2,788	14	2	0	1	11	487	563
North	32	15	0	4	13	0	102,440	986	1,195	4	0	0	0	4	132	187
South	56	22	9	3	21	1	607,849	1,276	1,280	8	2	0	0	6	296	318
Offshore	19	9	0	3	7	0	174,211	500	313	2	0	0	1	1	60	58
Michigan	13	4	0	5	4	0	31,593	309	320	3	0	0	0	3	110	125
Mississippi	12	3	4	0	5	0	93,424	282	330	5	0	0	0	5	146	160
Montana	15	1	0	1	13	0	63,531	299	328	12	0	0	0	12	117	120
Nebraska	19	8	0	0	11	0	115,773	631	721	10	1	0	0	9	350	350
New Mexico	48	20	1	15	12	0	284,714	1,548	1,429	6	0	0	0	6	206	191
Northwest	23	6	0	14	3	0	110,645	635	613	2	0	0	0	2	77	64
Southeast	25	14	1	1	9	0	174,069	913	816	4	0	0	0	4	129	127
New York	9	4	0	0	0	5	9,250	335	. .	0	0	0	0	0	6	. .
North Dakota	9	1	0	0	8	0	43,768	194	181	8	0	0	0	8	87	57
Ohio	28	13	0	6	8	1	67,300	805	768	0	0	0	0	0	9	9
Oklahoma	101	61	2	3	30	5	335,085	4,519	6,191	19	3	1	0	15	524	660
Pennsylvania	0	0	0	0	0	0	0	473	†764	0	0	0	0	0	39	†20
Texas	431	232	13	28	151	7	1,885,707	15,818	16,267	92	7	1	0	84	3,822	4,126
District 1	30	10	0	14	6	0	83,747	912	*2,328	6	0	0	0	6	313	*792
District 2	19	3	0	7	9	0	106,348	554	*1,942	5	1	0	0	4	202	*631
District 3	34	13	7	0	14	0	246,367	1,254	. .	8	0	0	0	8	359	. .
District 4	31	9	2	2	18	0	172,605	1,029	. .	9	1	0	0	8	342	. .
East	33	19	3	0	10	1	153,949	959	841	8	1	0	0	7	277	302
District 7-B	53	21	0	1	30	1	193,183	2,088	. .	18	3	0	0	15	728	. .
West	125	97	0	0	24	4	542,414	4,480	4,351	18	0	0	0	18	641	676
District 9	73	35	0	3	34	1	227,640	3,498	*5,834	16	1	0	0	15	881	*1,639
District 10	33	25	1	1	6	0	159,454	1,044	971	4	0	1	0	3	79	86
Utah	4	1	0	0	3	0	23,181	149	95	2	0	0	0	2	77	56
West Virginia	12	1	0	9	2	0	41,741	483	491	1	0	0	1	0	22	16
Wyoming	7	2	0	0	4	1	35,275	612	616	3	1	0	0	2	210	177
S.D., Nev., Ariz., Ida.	10	0	0	0	10	0	30,430	109	70	10	0	0	0	10	92	62
Total United States	**1,086**	532	29	78	421	26	4,777,516	38,816	42,833	**249**	22	2	2	223	8,647	9,443
Total prev. week	1,057	541	12	77	403	24	4,302,679	. . . . .	. . . . .	231	19	2	8	202	. . . . .	. . . . .
Cum. 1957	38,816	20,106	374	2,792	14,729	815	160,545,862	. . . . .	. . . . .	8,647	879	71	302	7,395	. . . . .	. . . . .
West. Canada	84	46	0	6	29	3	374,014	2,215	2,252	28	6	0	1	21	. . . . .	. . . . .

*Districts: 2 & 3, 1 & 4, 9 & 7-B, formerly combined; †Incl. New York. ‡Incl. Florida.

ROTARY RIGS OPERATING IN UNITED STATES

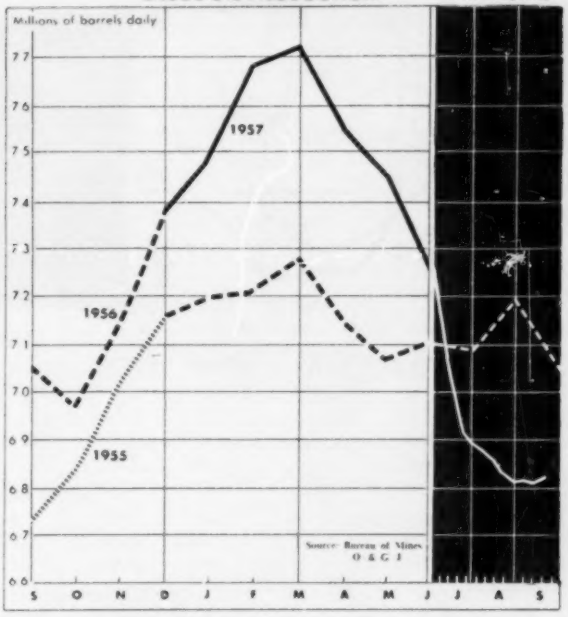


ACTIVE ROTARY RIGS*

Areas—	9-23-57	9-16-57	9-9-57	9-24-56
Alabama	4	4	4	6
Arkansas	26	25	26	21
Arizona	1	1	0	...
California	97	96	94	112
Colorado	69	65	63	65
Florida	1	1	1	3
Georgia	...	...	...	...
Idaho	...	...	...	...
Illinois	71	67	54	75
Indiana	8	11	8	18
Iowa	2	2	2	1
Kansas	148	151	151	170
Kentucky	10	12	10	13
Louisiana	450	450	442	439
North	63	62	67	62
South	292	285	276	377
Offshore	95	103	99	(†)
Maryland	1	1	1	...
Michigan	11	11	13	16
Missouri	...	...	...	1
Montana	33	30	26	47
Mississippi	40	38	42	29
Nebraska	34	34	36	26
Nevada	...	...	...	1
New Mexico	155	149	153	133
New York	...	...	...	...
North Dakota	40	39	37	26
Ohio	...	...	...	1
Oklahoma	266	271	255	262
Oregon	1	1	1	...
Pennsylvania	13	13	14	6
South Dakota	...	2	1	...
Texas	887	908	910	980
Gulf Coast	195	203	201	243
Offshore	3	2	4	(‡)
West	357	363	361	362
North	279	280	292	309
East	53	60	52	66
Tennessee	1	1	1	...
Utah	64	67	68	24
Washington	1	1	1	1
West Virginia	4	4	4	2
Wyoming	73	79	76	81
Virginia	1	1	1	...
Total United States	2,512	2,535	2,495	2,559
Western Canada	201	208	205	241
Eastern Canada	3	3	3	...
Grand total	2,716	2,746	2,703	2,800

*Hughes Tool Co.

CRUDE-OIL PRODUCTION

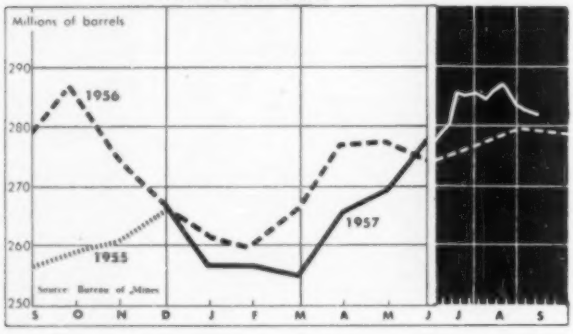


DAILY AVERAGE PRODUCTION FOR WEEK

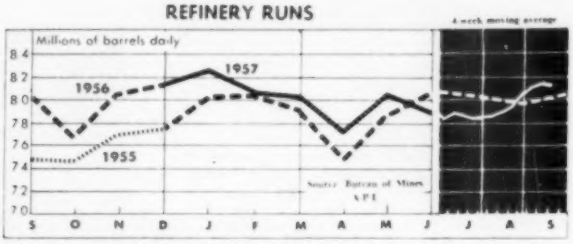
	September 21, 1957			Sept. 14
	Crude oil	Lease condensate	Total	total
Alabama	15,500	.....	15,500	15,440
Arkansas	80,750	250	81,000	80,750
California	927,600	.....	927,600	926,400
Colorado	150,100	.....	150,100	148,430
Eastern	52,800	.....	52,800	52,100
Florida	1,250	.....	1,250	1,250
Illinois	229,400	.....	229,400	219,500
Indiana	34,600	.....	34,600	33,700
Kansas	†341,500	.....	†341,500	†326,000
Kentucky	46,300	.....	46,300	46,500
Louisiana	712,800	70,500	783,300	783,100
North	122,800	2,500	125,300	125,100
South	590,000	68,000	658,000	658,000
Michingan	28,500	.....	28,500	28,300
Mississippi	99,275	4,275	103,550	103,550
Montana	74,150	.....	74,150	75,750
Nebraska	55,300	.....	55,300	55,400
Nevada	100	.....	100	100
New Mexico	249,700	3,700	253,400	252,990
North Dakota	36,200	.....	36,200	37,300
Oklahoma	†557,700	.....	†557,700	†549,500
Texas	2,720,000	54,400	2,774,400	2,774,400
Dist. 1	49,500	500	50,000	50,000
Dist. 2	125,500	8,600	134,100	134,100
Dist. 3	393,000	26,800	419,800	419,800
Dist. 4	207,000	6,100	213,100	213,100
Dist. 5	35,500	275	35,775	35,775
Dist. 6	120,500	5,900	126,400	126,400
East Texas Field	170,500	.....	170,500	170,500
Dist. 7-B	153,000	50	153,050	153,050
Dist. 7-C	142,000	3,675	145,675	145,675
Dist. 8	1,012,000	1,400	1,013,400	1,013,400
Dist. 9	204,500	600	205,100	205,100
Dist. 10	107,000	500	107,500	107,500
Utah	11,200	.....	11,200	10,830
Wyoming	292,700	.....	292,700	289,850
Others	‡250	.....	‡250	‡200
Total U. S.	6,717,675	133,125	**6,850,800**	6,811,340
Change from previous week, up			**39,460**	
Canada	†525,600	.....	†525,600	†476,500
Total U. S. production—Jan. 1-Sept. 21				1,925,117,825 bbl.
Same period last year (crude plus cond.)				*1,894,745,389 bbl.

*Includes 32,475,680 bbl. condensate. †Week ended previous Monday. ‡South Dakota.

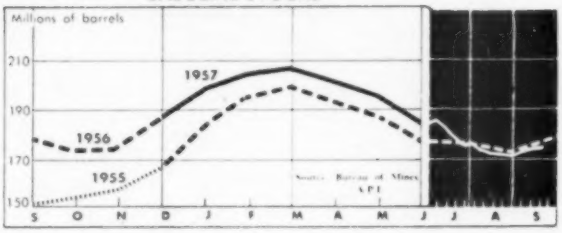
CRUDE-OIL STOCKS



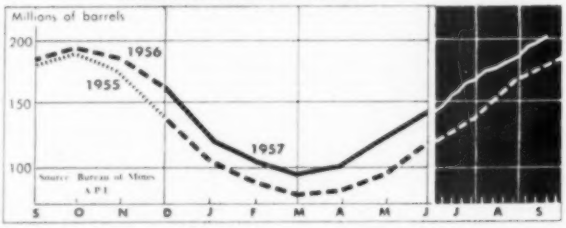
REFINERY RUNS



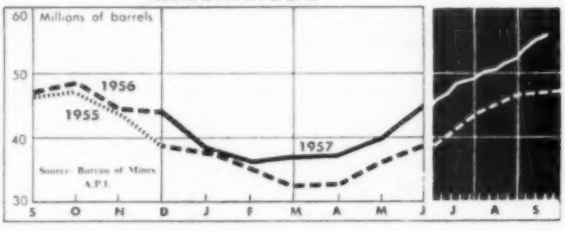
GASOLINE STOCKS



MIDDLE-DISTILLATE STOCKS



RESIDUAL STOCKS



CRUDE-STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	9-14-57	9-7-57	9-15-56
Pennsylvania Grade	3,185	2,230	2,551
Other Appalachian	1,769	1,667	2,410
Illinois, Indiana, and Michigan	11,305	11,186	11,359
Nebraska and North Dakota	2,489	2,413	2,364
Kansas	10,146	10,392	10,010
Oklahoma	21,695	21,650	25,949
Arkansas	2,699	2,727	2,924
Louisiana	19,400	18,966	17,164
North	3,300	3,144	2,947
South	16,100	15,822	14,667
Mississippi, Ala., and Fla.	2,696	2,607	3,055
New Mexico	9,824	9,797	8,278
Texas	125,824	126,524	121,805
East Texas proper	10,199	10,332	8,822
West Texas	61,313	60,273	59,097
Texas Gulf	23,933	23,754	23,488
Other Texas	30,379	32,165	30,398
Wyoming	16,817	17,008	17,098
Other Rocky Mountain	6,474	6,324	6,476
California	30,463	30,684	27,384
Foreign	†17,310	17,307	15,602
Total	282,096	282,482	274,429

*Bureau of Mines. †Includes 5,505,000 bbl. in California.

A.P.I. REFINERY REPORT, SEPTEMBER 20, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, September 1956—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,148	537.0	26.3	305.3	191.7	41,892	14,995	61,642	13,814	1,105	467.3	29.3	306.1	174.8
Appalachian:														
District 1	110	45.9	2.6	24.1	4.0	4,437	563	3,493	568	106	44.7	4.8	25.1	4.3
District 2	89	45.7	6.7	15.7	7.3	2,403	658	1,238	171	98	52.3	3.5	16.8	12.6
Ind., Ill., Ky.	1,385	724.1	67.4	278.3	166.8	30,158	7,111	23,752	5,544	1,451	764.4	70.4	307.2	147.3
Minn., Wis., Dak.	51	20.9	3.7	16.4	6.7	5,531	1,703	7,969	488	91	43.0	5.4	23.8	8.8
Okla., Kans., Mo.	674	407.7	14.7	167.9	30.0	13,946	1,805	14,802	1,052	671	374.5	14.0	165.8	25.9
Inland Texas	289	229.3	9.8	46.6	22.3	6,618	527	2,629	1,973	282	208.4	7.8	53.5	22.3
Texas Gulf Coast	1,925	946.1	126.3	432.2	237.4	23,100	3,514	19,000	8,040	1,944	917.2	116.9	482.8	245.7
La. Gulf Coast	630	373.3	30.0	171.0	45.4	10,784	3,550	8,247	1,655	699	347.4	59.2	197.0	49.7
N. La. and Ark.	97	31.0	8.9	16.1	7.0									
Rocky Mountain:						4,004	1,083	2,044	184	103	40.1	8.2	23.3	5.4
New Mexico	25	12.6	0.7	4.7	4.6	380	14	110	77	24	13.0	0.3	4.8	3.2
Other Rocky Mtn.	293	133.7	6.6	65.0	38.9	5,506	376	3,279	955	269	127.9	5.1	57.9	33.9
West Coast	1,114	523.0	6.7	151.3	355.0	25,299	436	16,932	21,482	1,181	502.3	4.2	181.0	328.4
Sept. 20, 1957	7,830	4,030.3	310.4	1,694.6	1,117.1	174,058	36,335	165,137	56,003	8,024	3,902.5	329.1	1,845.1	1,062.3
Sept. 13, 1957	8,056	4,078.0	334.3	1,768.3	1,105.9	173,805	36,001	162,853	55,183					
Sept. 21, 1956	8,041	3,905.9	338.4	1,754.0	1,096.9	176,944	33,657	148,816	47,835					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (89 octane)	11.50-11.75
Premium (98 octane)	14.25-14.50
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	11.00-11.50
Regular (92 octane)	11.25-11.75
Premium (97 octane)	12.75-13.25
Premium (98 octane)	13.00-13.50
California (rack):	
Regular (88 octane)	12.9
Premium (96 octane)	14.9
Premium (98 octane)	15.4
Caribbean area (cargoes):	
Regular (87 octane)	10.875
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.0
Breckenridge:	
Grade 26-70	3.5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.50-10.00
Diesel oil (58 d.i. and above)	9.125-9.75
Distillate No. 1	9.125-9.75
Distillate No. 2	8.50-9.00
Gulf Coast (cargoes):	
Kerosine 41-43	8.75-9.50
Distillate No. 2	8.75-9.50
New York Harbor (barges):	
Kerosine 41-43	10.75
Distillate No. 2	10.25
Diesel fuel, 48-52 d.i.	10.55
Caribbean area (cargoes):	
Distillate No. 2	9.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude-scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.75-2.00
Gulf Coast (cargoes):	
Bunker C fuel	$2.50-2.75
New York Harbor (barges):	
Bunker C fuel	$2.95
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.89
16-16.9	2.74	....	....	....	1.94
17-17.9	2.78	....	....	....	1.99
18-18.9	2.82	....	....	....	2.04
19-19.9	2.85	....	....	....	2.09
20-20.9	2.89	$2.75	....	$2.62	2.14
21-21.9	2.93	2.77	....	2.64	2.19
22-22.9	2.97	2.79	....	2.66	2.24
23-23.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low cold test Gulf Coast. ‡Sour.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, July 26, 1957.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.65
Middle District	4.47
Southwest Pennsylvania	4.18
West Virginia	4.00
Buckeye Grade	4.00
Zanesville Grade	3.04
Illinois Basin	3.15
Canada:	
Leduc-Woodbend	2.74
Redwater (Alta)	2.63
Smiley (Sask.)	2.40
Pembina	2.61

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 41°-41.9°, Puerto La Cruz	3.34
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	**$2.12**
Iranian, 34.0°-34.9°, Bandar Masur	**2.04**
Iranian, 34.0°-34.9°, Abadan	**1.99**
Iraq, 36.0°-36.9°, Fao	**2.00**
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	**1.85**
Qatar, 41.0°-41.9°, Umm Said	**2.23**
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.59
Iraq, 36.0°-36.9°, Tripoli, Banias	2.59
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.75

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(Latest reported spot fixtures)

★ Gulf-U.S.N.H., clean (USMC—30%)	$2.00
Gulf-U.S.N.H., dirty (USMC—35%)	1.85
★ Carib.-U.S.N.H., clean (USMC—35%)	1.76
★ Carib.-France, dirty (USMC—70%)	1.97

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FOR SALE: Scintillator, precision model 118 Royal. Joseph Kesl, Jr., Bank of Edwardsville Bldg., Edwardsville, Ill.

CABLE TOOL RIGS—28-L Bucyrus 34-S Walker-Neer: with or without tools: rigs in A-1 condition: now operating near Tulsa. Box K-347, The Oil and Gas Journal, Tulsa, Oklahoma.

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216 West 2nd St., Tulsa, Okla.
Ph. LU 4-4229

Rogers & Wright, Inc.
710 Peoples Bldg., Charleston, W. Va.
Ph. DI 3-0171

Midway Supply Co.
Box 731, Jackson, Mich.
Ph. STate 2-0383

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DUAL FUEL (GAS OR GASOLINE)

Model 145GZ, 200 HP @ 2000 RPM, 12 volt starter and generator, power take-off.

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250—30,000# Capacity. Model 718.
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750-Twin Disc, type Lysholm-Smith, spec. #90030. Rated to 250 HP @ 2500 RPM. Use with GM 671, 210, Buda, Cummins.

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CONTRACTOR desires to sell a Wilson Mogul Spudder unit powered with a Waukesha 145 H.P. engine, 65 ft. double pole mast. Price $7,000.00 Also will go on partnership basis with someone who can put machine to work. Independent Drilling Co., Box 456, Hondo, Texas.

FOR SALE—(5) 28L Bucyrus-Erie Cable Tool Drlg. Rigs. With or without tools. Quitting business due to ill health. Write or call L. E. Reames Drlg. Co. Fairmount Addition, Pawhuska, Okla. Phone 92 Mon. through Fri., 8:00 A.M. to 5:00 P.M. Sat. 8:00 A.M. to 12:00 Noon.

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50,000 ft. 16" O.D.—1/4" wall, 42 lbs. per ft. 16' to 20' lengths, plain end. Very good used condition. Phone, Write or wire

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Phone HA 1-1000

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1 36L BUCYRUS Spudder complete with 5 and 7 inch tailing in tools. Dog house, butane tank, junk rack and light plant. Rod and tubing tools and hand tools. Phone Office 144, Res. 614, Cleveland, Oklahoma.

FOR SALE: Rotary Rig Complete with National T-20 Drawworks single powered by WAK Waukesha Engine. 87' Lee C. Moore Jackknife 7¼" x 14" Oilwell Pump single powered by Le Roi L-3000 V-12 engine 5,000' of good 4½" drill pipe, 5 Drill Collars and all necessary equipment to complete rig. Call or write Travis Drillers, Inc., P. O. Box 1097, Austin, Texas. Phone GR 7-7725 or GR 8-5044.

FOR SALE: 1—Mayhew 2000 drilling rig mounted on F-8 Ford tandem, all new motors, 2,000' 2⅞" new National drill pipe 30' long. Winch truck with oil field bed, water tank, dog house on wheels, 2-wheel 10-ton pipe trailer, pick-up truck. Rig is in first class condition, all tools to drill with. Unit is now at 7901 Alabama Ave., St. Louis, Mo. If interested call Flanders 1-1010, Mr. Paul Andrews, St. Louis, Mo.

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1—Wyatt 30" x 70' Stabilizer 160# 30 tray
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2—12' x 45' Storage Tanks, 25#
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1—9' x 75' Tower, 20 Trays, 25#
1—18" x 32' Tower, 15 Trays, 160#
1—8½' x 25' Tank.
5—Packed Towers 14" x 40', 18" x 23', 160# Wyatt 1950.
1—Poly Reactor, 550#, 24" x 28'.
1—12" x 27' Absorber, 20 Trays, 450#.

HOT-OIL PUMPS

3 Pacific ITB, 400 gpm.–2,000' hd. 735 gpm–3,100' hd.
5 Pacific SVTB, 612 gpm–600' hd. 324 gpm–480' hd, 308 gpm–516' hd, 193 gpm–389' hd.
1 Pacific HVTB (unused) 1270 GPM–408' Hd.
BJ hot oil pump, 3 x 9, 14 st, 324 gpm, 4600' hd.

HEAT EXCHANGERS

4—Kellogg Adm. Fltg. Hd. 2200, 1300 Sq. Ft., 315#
4—Kellogg Steel Fltg. Head. 800, 650, 500 Sq. Ft.
18—GR Fin Tubes, 73 Sq. Ft.
6—Brown fintube exchangers, 300# 140 Sq. Ft. 4-6 chrome
9—Steel 1,000, 900, 800, 600, 500 Sq. Ft.
6—Adm. 785, 742, 425 Sq. Ft.
30—304 SS shell & tube condensers 100-1000 Sq. Ft.
2—4-6% Chrome 1,000 500 Sq. Ft.

COMPRESSORS

1 Worth LTC-6 800 hp.
3 Penn Comps 100 CFM 500 lbs.
385 CFM 160 lbs.

MISCELLANEOUS

6—Bird Centrifugals 32 x 50, 24 x 38, 18 x 28.
5—Sweetland Filters No. 12, No. 10, No. 7, No. 5.
4—Rotary Vac. Filters, 10 x 12, 8 x 10, 5 x 8.
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FOR SALE—By bid: Cardwell Spudder, fully equipped. For inspection, inventory, contact Clayton Krehbiel, 518 East Third, Ellinwood, Kansas. Bidding closes October 5, 1957. Right reserved to reject any or all bids.

FOR SALE

2—45 ST Star Spudders. 2—43 C Star Spudders. All equipt with drilling engines, 8" and 6" tools, floor sleds with half house, forge and tool sled, light plant, dog house and tools. $2,500.00 each. Call CH 2-3633 or RI 2-4025 Tulsa. Write 222 Kennedy Bldg., Tulsa.

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Various Constructions, Diameters and Heights.

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BESSEMER GAS COMPRESSORS—3 type 10 twins direct connected units—Boswell-Frates Company, 1003 Kennedy Building, Tulsa, Oklahoma.

FOR SALE—50,000 ft. New and Unused 8⅝" O.D., 22.56#, A.P.I. 5-L Grade B Electric Weld Line Pipe, D.R.L., P.E. Bev. 30°. Domestic pipe and Moody inspected. Located Harvey, La. Can be coated at present location and shipped via barge, rail or truck. Surplus due to change to larger size. Price $198.47 C. Ft. Olin Gas Transmission Corporation, Monroe, La.

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GAS BOOSTER PLANT complete, equipped with two Type Ten Twin Cooper-Bessemers housed in Braden Steel sectional building. D. F. O'Rourke, National Bank of Tulsa Building, Tulsa, Okla.

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Five 83-ft. wooden-hull Coast Guard Cutters converted for use as personnel and supply carriers. Two 112-ft. steel-hull LCT heavy cargo carriers. One 315-ft. steel-hull LST drilling platform tender. All vessels are in good condition and fully equipped for operation.

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SPUDDER WANTED — fifteen hundred or two thousand feet, good condition. Medina Gas Co., Aylmer, Ontario.

WANTED DRILLING EQUIPMENT: Used Failing 2500 drilling rig 1954-57 model. Write William G. Geary, First Nat'l. Bank Bldg., Colo. Springs, Colo. or phone ME 5-2858.

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PLANT ENGINEER for Refining Company in Mid-Continent area. Project estimating, drafting and general engineering experience. Give detailed resume of qualifications. Box K-352, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

CHEMICAL OR PROCESS ENGINEER—Minimum of B.S. in Chemical Engineering, Refinery Engineering or equivalent. Experience required as process engineer or general experience in Chemical Engineering Laboratory of large oil refinery. With major oil company in Tulsa. Liberal company benefits. Address all replies, giving age, education, resume of experience and salary expected to Employee Relations Department, P. O. Box 2039, Tulsa, Oklahoma. Replies will be kept confidential.

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Young aggressive independent oil company has a position now open for a SUBSURFACE GEOLOGIST. Two to five years experience in West and/or West Central Texas, Midland location. Send complete resume of education and experience, including salary requirements. All replies confidential.

Box K-359,

The Oil and Gas Journal,
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Box K-341
The Oil and Gas Journal
Tulsa, Oklahoma

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Box K-358,
The Oil and Gas Journal,
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Send detailed resume to
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Excellent opportunity with a new and expanding moderate-sized refinery in the Middle West. Applicants must have had experience in maintenance of modern refinery units, including scheduling, planning and coordination of work. Prefer graduate engineer. Salary commensurate with experience. Reply:

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DRILLING EQUIPMENT ENGINEER

Graduate engineer preferably mechanical or petroleum with minimum 7 years experience. For assignment in New York Office. Familiar with design, manufacture and maineanance of drilling and exploration equipment and supplies. Knowledge of manufacturers and their products essential. Some travel U. S., occasional overseas.

Write outlining personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 234

ARABIAN AMERICAN OIL COMPANY
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NEW YORK 22, NEW YORK

HELP WANTED

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs, $5.00 cash. OIML Co., Box 2683, Tulsa, Okla.

SEISMOGRAPH TECHNICIAN with thorough field practice, fully conversant with recent developments and interpretation, wanted to assume responsibilities of field supervision and interpretation, by French concern exploring in Libya. Furnish full information on education, experience, salary. Box K-350, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT and Office Manager, preferably in middle or late thirties, who can accept responsibility for all financial accounting, bookkeeping and tax operations and policies of independent producer in mid-continent area. Excellent opportunity for right man. Salary $8,000 to $10,000, depending upon qualifications. Send all details and photo to Box K-345, The Oil and Gas Journal, Tulsa, Oklahoma.

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Excellent opportunity with a West Coast Independent Oil Company (San Joaquin Valley). Refinery Experience, Process Design and Operation essential. Must have Engineering Degree. Salary commensurate with ability and experience. Reply outlining personal history, photograph and work background.

Box K-335,
The Oil and Gas Journal
Tulsa, Oklahoma.

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The highly competent performance of Pipe Line Engineering Services by our present staff of professional engineers is leading to a continuously growing demand for the services of PIPE LINE TECHNOLOGISTS, INC., and affiliated companies. To meet this demand for growth and, at the same time, to maintain the high-quality service that has established our excellent reputation throughout the world, we will continue to have job opportunities for thoroughly capable and experienced Pipe Line Engineers.

As we plan for further growth, we have openings at both intermediate and advanced levels in both the United States and foreign locations. Resumés, which will be kept strictly confidential, are invited from graduate engineers with experience in responsible capacities in hydraulic and mechanical design of pipe lines and pipe line facilities, including pump stations, compressor stations and terminals. Openings also are expected for experienced construction engineers capable of being assigned as Project Engineers.

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Salaries commensurate with training and work experience. Liberal, well-balanced employee benefit plans.

Please include in resumé full particulars regarding education, experience and salary requirements. Arrangements will be made for individual interview with interested and qualified persons.

PIPE LINE TECHNOLOGISTS, INC.
P. O. Box 6957
HOUSTON 5, TEXAS

HELP WANTED

WANTED: Petroleum engineer with working knowledge of production and water flood operations, reservoir and economic evaluations to fill responsible place in active North Texas company. Write giving full particulars regarding personal history and work experience. Box K-364, The Oil and Gas Journal, Tulsa, Oklahoma.

SAFETY ENGINEER for expanding offshore and land drilling contractor and producing company operating in the Louisiana Gulf Coast area. Experience in drilling activities and college degree desirable. Salary commensurate with ability and experience. Send photograph and complete personal history, including education, experience and salary requirements to Box K-360, The Oil and Gas Journal, Tulsa, Oklahoma.

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Broad-range job of technical writing and editing, including brochures, press releases, technical papers, reports, and monthly summary of petroleum-refining developments for high-level outside circulation. Desire engineer or chemist with knowledge of petroleum-refining and petrochemicals fields, plus prior writing experience. For more particulars send name and address to:

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5-10 years experience doing market research in hard goods, ability to handle public contacts. MBA or equivalent. Mechanical Engineering degree desirable. Starting salary $10,000 or up—commensurate with ability.

NEW PRODUCTS ENGINEER

5-10 years experience in related industry. Initially responsible for technical aspects of new products market research. Will develop research and development department. BSME required. Starting salary $10,000 or up—commensurate with ability. Liberal fringe benefits including profit sharing, paid retirement, paid hospitalization, and life insurance, and air conditioned modern office building.

Please send detailed resume including salary requirements.

Box K-365,
The Oil and Gas Journal,
Tulsa, Oklahoma.

HELP WANTED

WANTED—Experienced Hydraulic Casing Pulling Unit Operators. Good salary, steady work. Call GL3-6551, or write Box 221, Great Bend, Kansas, Forbes Casing Pulling Company.

SITUATIONS WANTED

ACCOUNTANT, 28, degree. Experience in production, drilling and exploration. Desire position in Denver area. Box 574, Dallas 21, Texas.

LATIN AMERICAN REPRESENTATIVE, graduate engineer over 20 years experience Latin investigations and management in addition domestic petroleum and mining operations desires affiliation company entering Latin American field. Have top echelon contacts with wide distribution. Box K-363, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST—Dr. Phil. desires new fields of activity outside U.S.A. 16 years practical experience exploration and applied geology. Europe, S. America, Africa. Box K-362, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT: Desires oil field accounting records to keep at home for drilling contractor and producer, 21 years experience in Oklahoma. Box K-361, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT—General and cost. Broad industrial experience in supervisory capacity. Oil production. Standard cost installation and operation. IBM methods and procedures. P. O. Box 2634, San Antonio, Texas.

STRATIGRAPHER. Highly experienced. Research or Exploration. Could organize department. Geological administrative training. Domestic or foreign. Box K-343, The Oil and Gas Journal, Tulsa, Oklahoma.

LEASE-LANDMAN - ATTORNEY (Okla.). 25 yrs. experience, independent and major company. Houston residence. Will relocate. Box K-342, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: Age 30, seven years major company experience in drilling, production, workover, artificial lift, secondary recovery, automation. Now in supervisory position. Desire responsible position with aggressive independent or major. Venezuelan experience. Box K-356, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICIST, Degree Geology; 4 years review interpretation, 6 years field, with Major Oil Co., 10 years contract Co., past 6 years supervisor. 2 years experience California rest Gulf Coast and Mid-Continent. Age 49. Desires job coordinating Geology and Geophysics with Oil Co. Box K-353, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER — Four years, service company, two years production experience in Texas, Foreign. Workover, completion, acidizing, fracturing, and perforating. Supervisory experience. Prefer domestic employment. Dan Rhoads, 309 N. Tacoma, Tulsa.

Petroleum Engineer-Lawyer

Desires location in Washington, D. C. as company liaison. Experienced in contract and technical product development techniques of industry and federal agencies.

Box K-366, The Oil and Gas Journal, Tulsa, Oklahoma.

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OIL PRODUCING company interested in buying fair-sized oil deal, anywhere from 100 bbls. to 300 bbls. per day. Kansas or Oklahoma preferred. P. O. Box 2454, Tulsa, Oklahoma.

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EXPERIENCED, reliable operator wants partners in some good Oklahoma drilling deals. P. O. Box 1585, Tulsa, Oklahoma.

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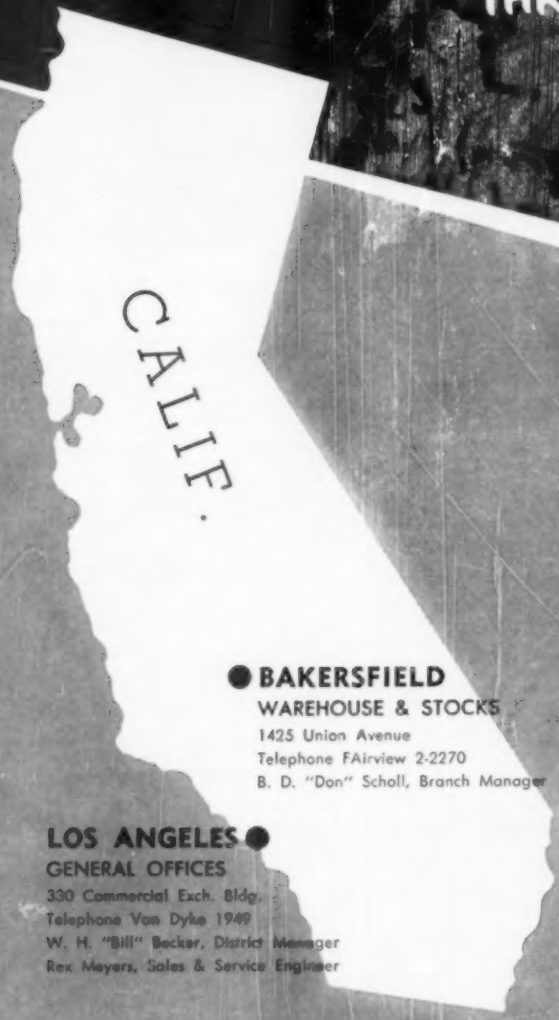

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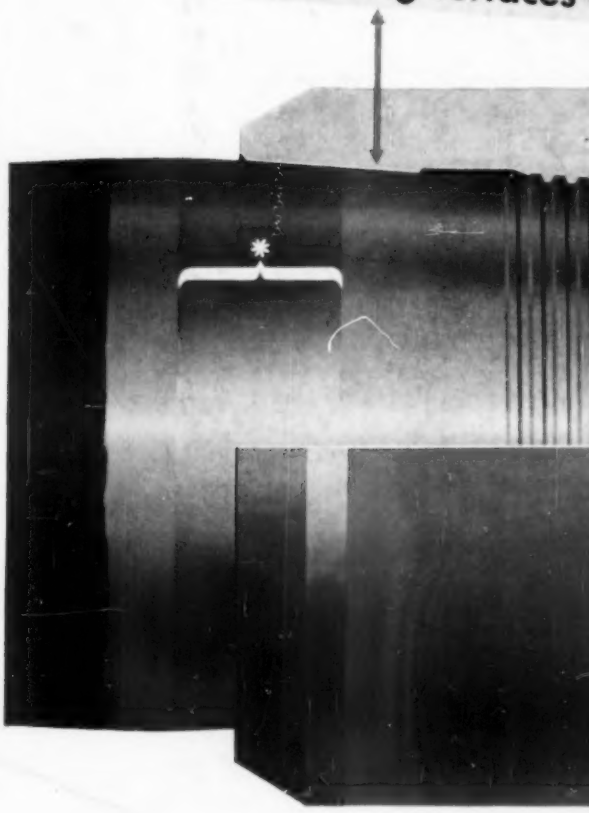

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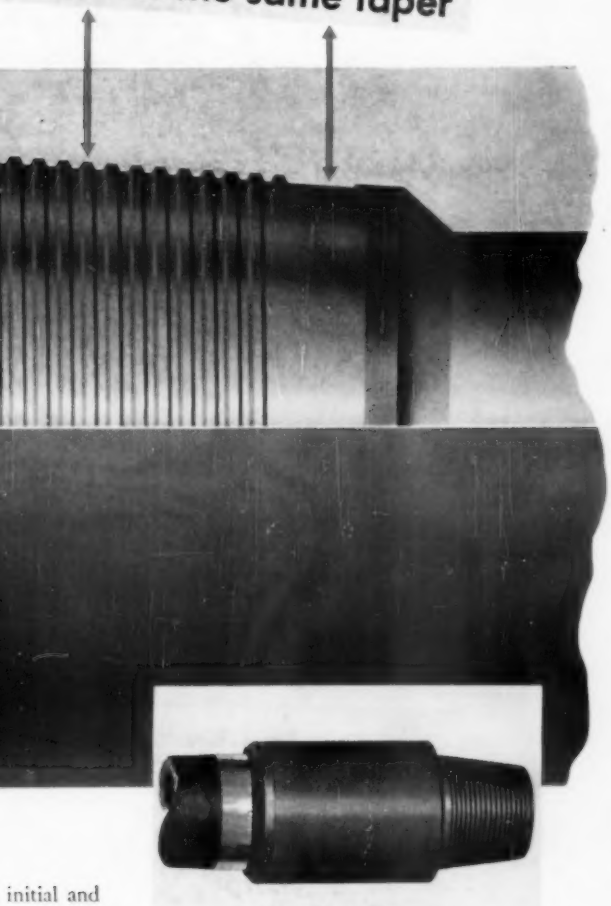

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